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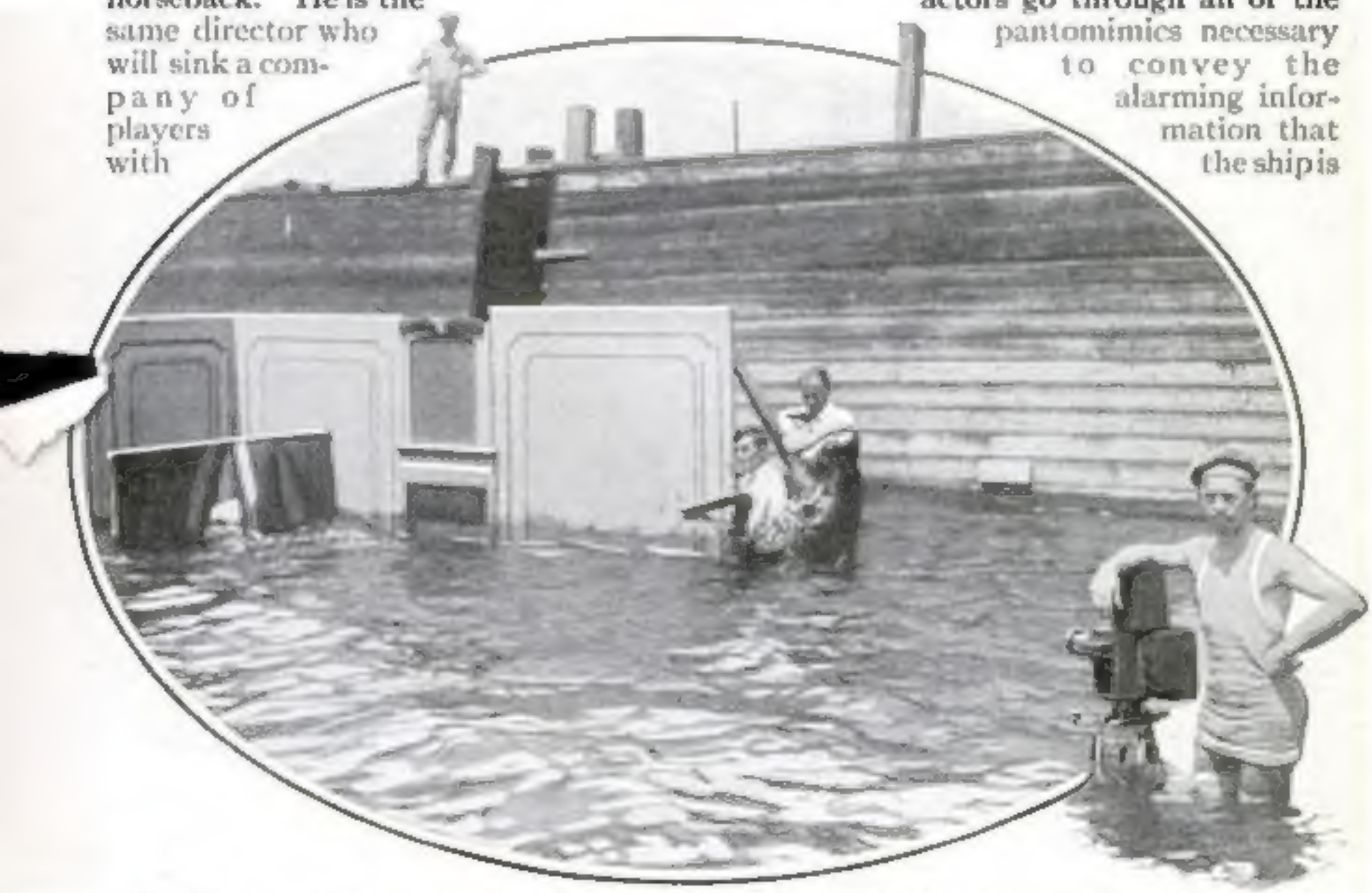
Catastrophes by the Foot

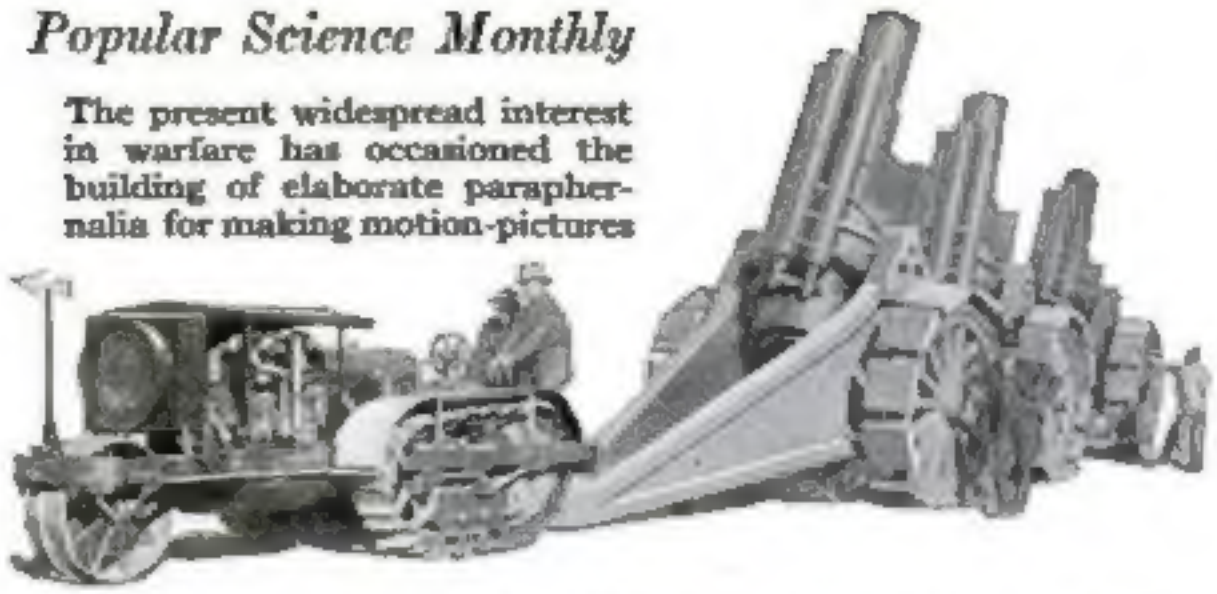
TO paraphrase the words of a well-known humorist, there is motion-picture realism and, on the other hand, there is motion-picture realism. There is cinema realism which consists mainly in cheap and unconvincing illusions. Into this class falls the director who substitutes a miniature dreadnought in a bathtub for the real article, or the director who mounts his camera on a rolling platform, this device giving to the steady deck of a ship the appearance of rolling and tossing. On the other hand there is the director who will command his players to leap real precipices on horseback. He is the same director who will sink a company of players with a stretch of nailed-down scenery on a floating dry-dock. This type of director is the man who is giving the public its most shivery thrills.

Sinking a "set" on a floating dry-dock has been done more than once. In fact, it is a favorite trick. A stateroom of a ship is built of wood strips, painted canvas and a porthole. It is erected on the platform of a floating dry-dock and the camera adjusted. The action, dramatically speaking, starts. The sea-cocks of the dock are opened and it gradually sinks. Water creeps up—the ship is sinking! The cameraman cranks, the actors go through all of the pantomimics necessary to convey the alarming information that the ship is



Would you care to be a motion-picture operator or a motion-picture actor, after this? Would you look brazenly out of the picture and care naught for the opinion of the man on the wharf?

foundering. When the water is lapping the handsome chin of the hero and the heroine is getting the life preservers from under the berth—the director shouts, "Cut!" When the scene on the screen shifts from this to a real ship tossing about in a storm, the illusion is vivid and convincing.



The present widespread interest in warfare has occasioned the building of elaborate paraphernalia for making motion-pictures

But action for the director and the actors doesn't stop here. In addition to having the whole Atlantic Ocean dumped into his parlor just as the clock strikes noon, the poor rich actor dons his summer tweed ten minutes later and hurries to another part of town to take part in a staged battle, or "war stuff."

The camera man, under the umbrella on the platform, is busily filming the wooden Krupps as they are Krupping away at the invisible enemy

Here the directors are compelled to resort to whatever alternatives stage carpenters and studio mechanics can devise. One of the latest of these invasions into carpenter shop realism is a successful attempt in imitating the 12-inch siege howitzers employed by the Germans. The huge guns are constructed almost entirely of wood which is supplemented at all wearing points with metal. The guns follow the well known Krupp design faithfully. A recoil mechanism is provided as well as a means for regulating the angle of the gun barrel. The wheels are provided with caterpillar treads to enable them to climb over rough ground. The powder charge used in firing is mixed carefully in the studio laboratory. In making the picture the guns are drawn from the point on the "firing line" by a tractor driven by a gasoline engine.

All that glitters is not gold; all guns are not of steel. These are of wood—perfect imitations of the famous Krupp howitzers

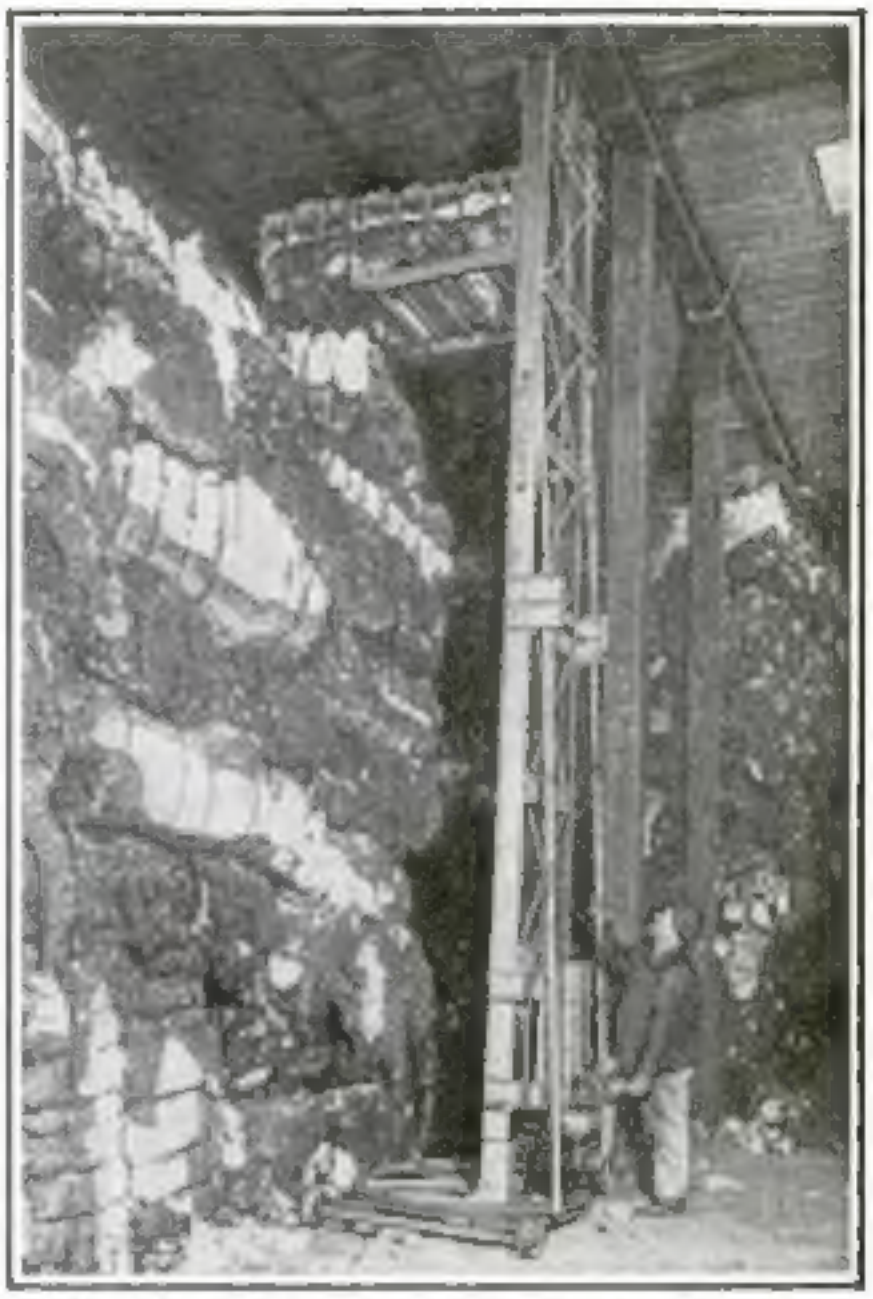
Revolving Portable Elevator

LOADING barrels, cotton bales and crates with the aid of a revolving portable elevator, which has just been placed on the market, has enabled the manufacturer to reduce labor costs and at the same time complete his task with a thoroughness heretofore impossible. The elevator covers a wide range of usefulness. Machines have been supplied for lifting corpses in morgues and for placing coffins in niches such as are used in South America. In fact, the machine can be used to pile anything at all.

Loading barrels into freight cars has been a difficult and hazardous undertaking. With the new elevator it is simple. In one instance a railroad company was spared the necessity of building a loaded platform all along its yard siding. The barrels were rolled upon the elevator platform from two planks, on one of which an operator stood. The platform was then cranked up to the desired height, and the upper base swung around ninety degrees on the turntable, which put the barrel into the proper position to be rolled off on the car floor.

In one instance the elevator piled crated gas-engines inside a box-car, and piled them so compactly that the manufacturer is now able to take about thirty per cent more of his gas-engines in one car-load than he could handle

Loading barrels into freight cars is simplified by this portable elevator



As the stack grows the elevator is adjusted to the new height

before he obtained the revolving portable elevator. In warehouses bales of cotton can be piled, neatly and squarely, in stacks up to twenty feet high. In stacking barrels of oil the machine is especially valuable. The barrel is pushed on the elevator platform, the operator cranks up the machine to raise the platform to the desired height, and when the platform reaches it, he swings the upper structure around and simply rolls off the barrel on to the skids.

To enable the machines to be taken through low doorways from one room to another they are provided with hinges in the uprights at a point six feet, six inches from the floor. The hand-operated machines are provided with a patented safety-hoist which makes it absolutely impossible for the operator to be hurt by a flying crank.

Not only does this machine do its work quickly and without danger, but its operation is not costly, since one man can run it easily. Furthermore, much space is saved by packing articles closely.

Modern Methods for Exterminating the Mosquito Pest

NEXT to draining, the best way to abolish mosquito breeding places is to treat the water so as to kill the mosquito larvae. While many substances have been tried for this purpose, nothing has given such good results as petroleum, according to experts of the United States Department of Agriculture. Common kerosene of low grade is most satisfactory as regards efficiency and price.

It has been found that spraying with a portable pump is the best way to use the oil. Small ponds, however, can be sprinkled out of an ordinary watering-pot with a hose nozzle, or for that matter pouring it out of a dipper or cup will be satisfactory. In larger ponds pumps with a straight nozzle may be used. A straight stream will sink and then rise and the oil will spread until the whole surface of the water can be covered without waste.

In choosing the grade of oil to be used two factors must be considered; it should spread rapidly and should not evaporate too quickly. Heavier grades of oil will cling together in spots and the coating will be necessarily thick. It has been found that one ounce of kerosene is sufficient to cover fifteen square feet of surface, and in the absence of wind, such a film will remain persistent for ten days. Even after the iridescent scum apparently disappears there is still an odor of kerosene about the water. A mixture of crude oil and kerosene has been found to be effective in killing mosquito larvae. It has one advantage over pure kerosene in that it does not evaporate so quickly.

Special attention should be paid to little pockets of water that form around the edges of ponds, for it is in such places where the water is not disturbed by wind or otherwise that the larvae breed in greatest numbers. Larvae do not breed in open stretches of water where the surface is rippled by the wind.

In the fight against the mosquito in Panama, the government experts found that a larvicide composed of carbolic acid, rosin and caustic soda was very effective and thousands of gallons of it were used.

Threshing by Night Under Electric Light

THE farmer like the city man does not allow daylight to put a quietus on work. On the other hand he labors into the night just as assiduously as the city man, and makes hay not only while the sun shines on this side of the earth, but while the sun shines on the other side, too. With the aid of a new portable generator recently placed on the market he can do his threshing at night, and do it with a degree of thoroughness not excelled in the brightest sunlight.

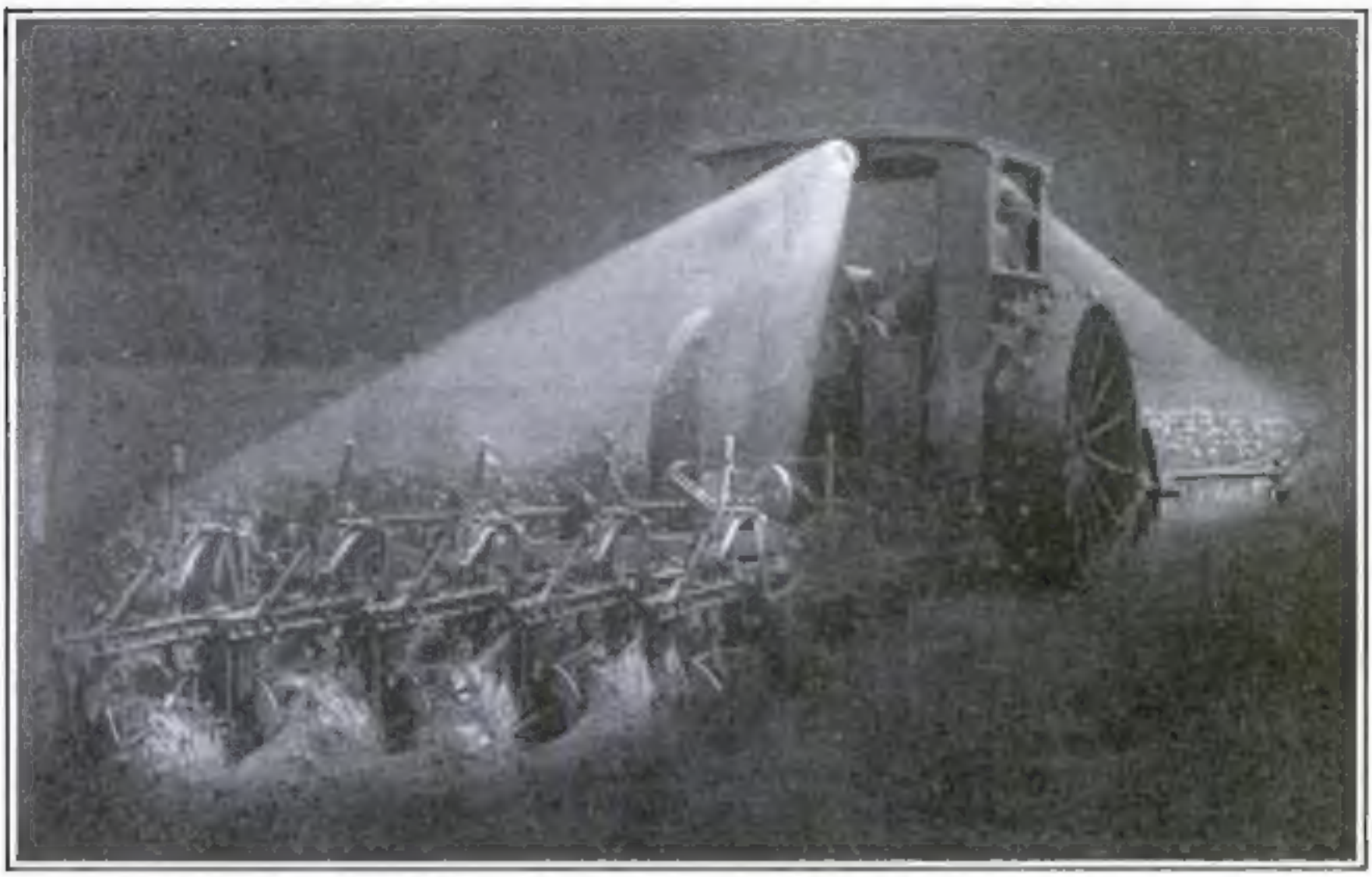
The dynamo is drawn up beside the thresher and is driven by a belt from the threshing machine. The apparatus is sufficiently powerful to light at least one arc light, which throws a brilliant white light on the field of operations. When the farmer finds the spring thawing season suddenly thrust upon him and the ground ready to be plowed he can work far into the night with the aid of the same portable generator. It supplies light for two projecting lamps, one in front to light the way, and the other in the rear to show the plowed area.

Uncle Sam Says Miraculous Wheats Are an Old Delusion

THE notion that there is a wonderful wheat which will make the fortune of anyone who plants it seems to be almost as old as agriculture itself. In this country, at least, such an assertion was made for the so-called Jerusalem wheat as early as 1807, and, under the name of Alaska wheat, this identical variety is still being pushed upon the unwary at exorbitant prices for seed. Almost equally exaggerated claims are made for the Stoner variety, but this particular wheat has not such a long history.

Because of the many attempts that have been made by promoters to foist these wheats, under one name or another, upon the farmers of the country, the Department of Agriculture has made careful tests of their value. The results of these tests are said to show conclusively that neither of the wheats possesses any peculiar quality which justifies high prices for the seed. Many varieties grown commercially throughout the country have proved to be superior to either the Alaska or the Stoner.

Where the Modern Farmer Spends His Evenings



Plowing a field at night with the aid of two powerful lights which enable the operator to see the path ahead of the machine he is driving, and the width of plowed field in its wake

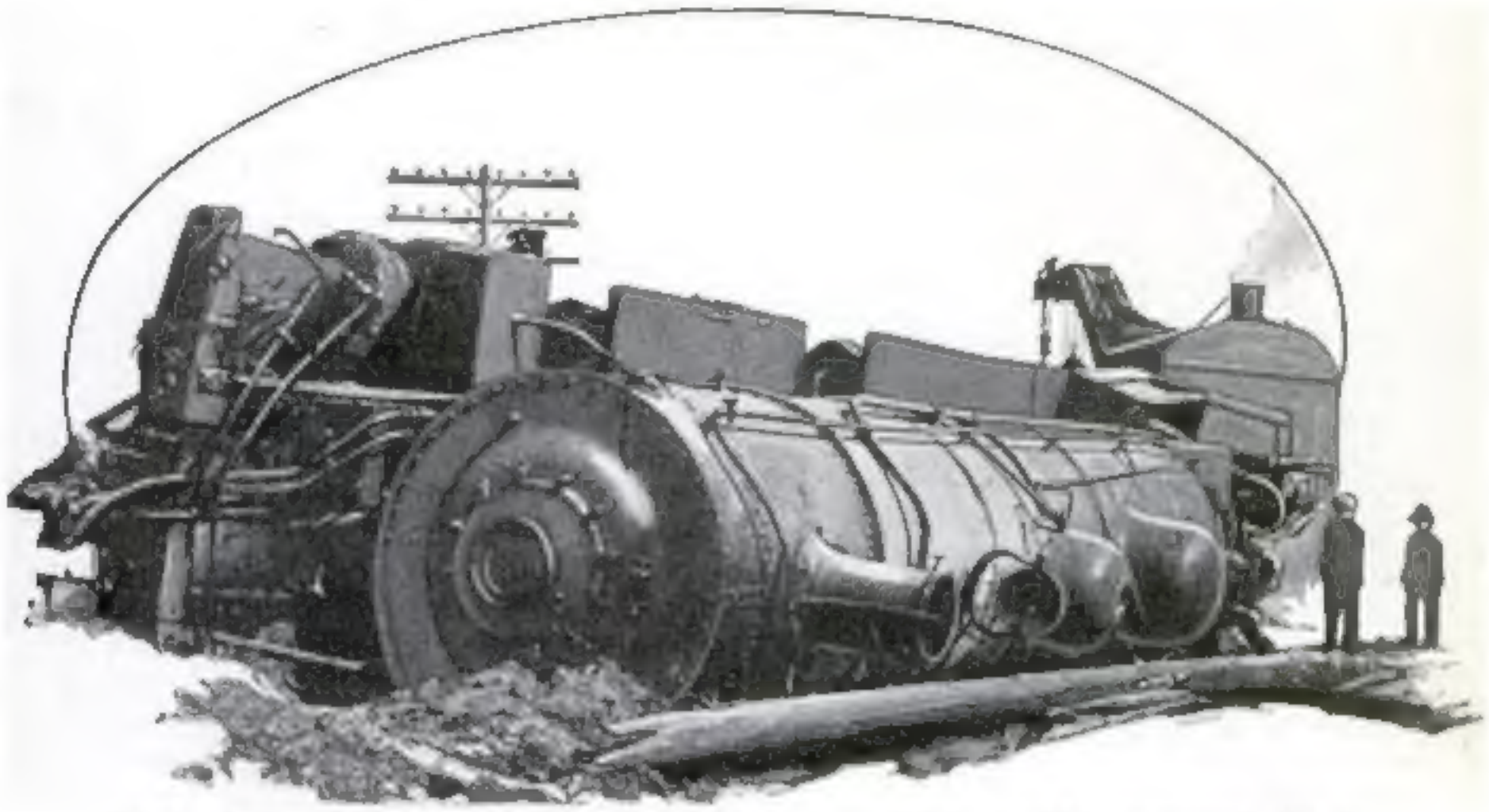
Threshing after sunset. The arc light derives its current from a dynamo which is belt-driven from the threshing machine. In this way the farmer makes hay while the electric light shines

Leaping Horses That Are Unafraid

Though horses usually hesitate to jump over obstacles near human beings, the horse of a United States Army lieutenant jumped over a mess table surrounded by soldiers. He showed no hesitation, and did not upset even the bottle of sauce or pitcher of coffee on the table though they were dangerously near the flight of his heels

At right, a feat of horsemanship not without an element of danger to both horse and rider. The illustration below shows "Rabbit," a privately-owned horse of Washington, D. C., hurdling a high-powered racer without making a scratch in its white hood

Minute Men of the Rails



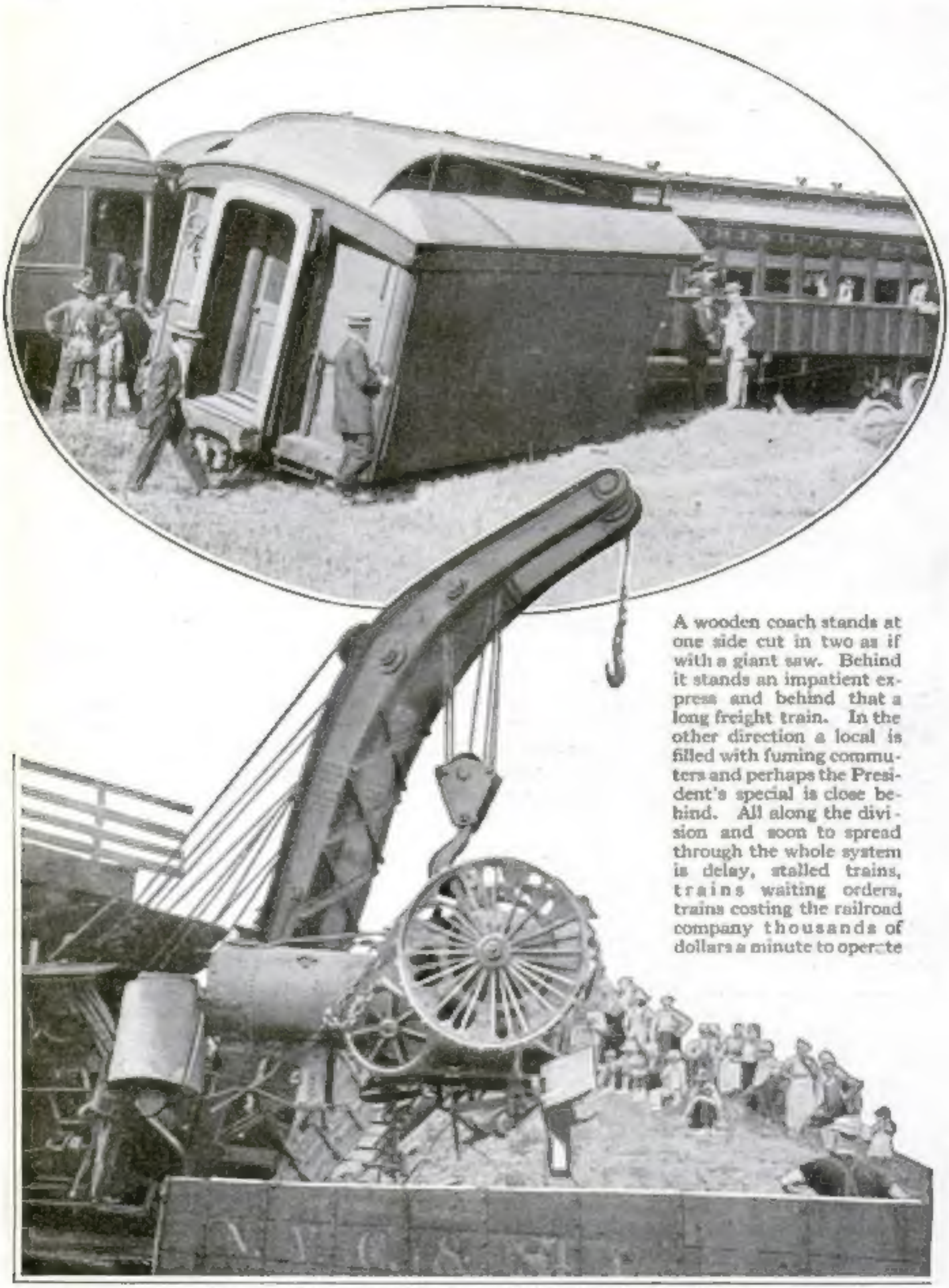
Much of the fascination of railroading centers around the wrecking crew and the important and ofttimes gruesome work of clearing wreckage and keeping the lines open

WRECKING-TRAINS are located on every division of important railroads, standing idle in the yard, waiting for calamity. A crane-car, with sufficient power to lift a freight-car as a child lifts a toy; a supply-car, containing rope, cables, chains, jacks, crow-bars, tools, lanterns, fire apparatus, dynamite, rails, ties; a caboose for the wrecking-crew.

When the word comes over the wire that the express and the fast freight have tried to see which could butt the other off the track, the wrecking-crew assembles in a hurry. They are picked men—these minute men of the rails—each with his specialty. Mechanics, track-men, men skilled in explosives, strong men, slender men, at least one small but muscular man, they come from roundhouse and shop, freight yard and office, at the supreme call. The wrecking-boss takes command, the best engine available backs down, and with a clear track the wrecking-train gets to the disaster, often ahead of the special containing doctors and nurses.

There is only one order to be obeyed when the wrecking-crew gets in action—"Save life." But once the victims are extricated—and they are taken out in a remarkably short time—the order changes. It is not, as might be expected, "Save property." It is "Clear the lines." It makes no difference that five jumbled freight-cars contain expensive automobiles, or pianos, or phonographs, or fruit, which might be saved by careful work. If the contents cannot be saved in less than an hour, there is only one thing to do. The big steam crane is backed down to the mess, a long, tentacle-like hook descends, chains and ropes are brought into play, and slowly, surely, almost daintily, the crane swings the wrecked freight-car and its contents to one side.

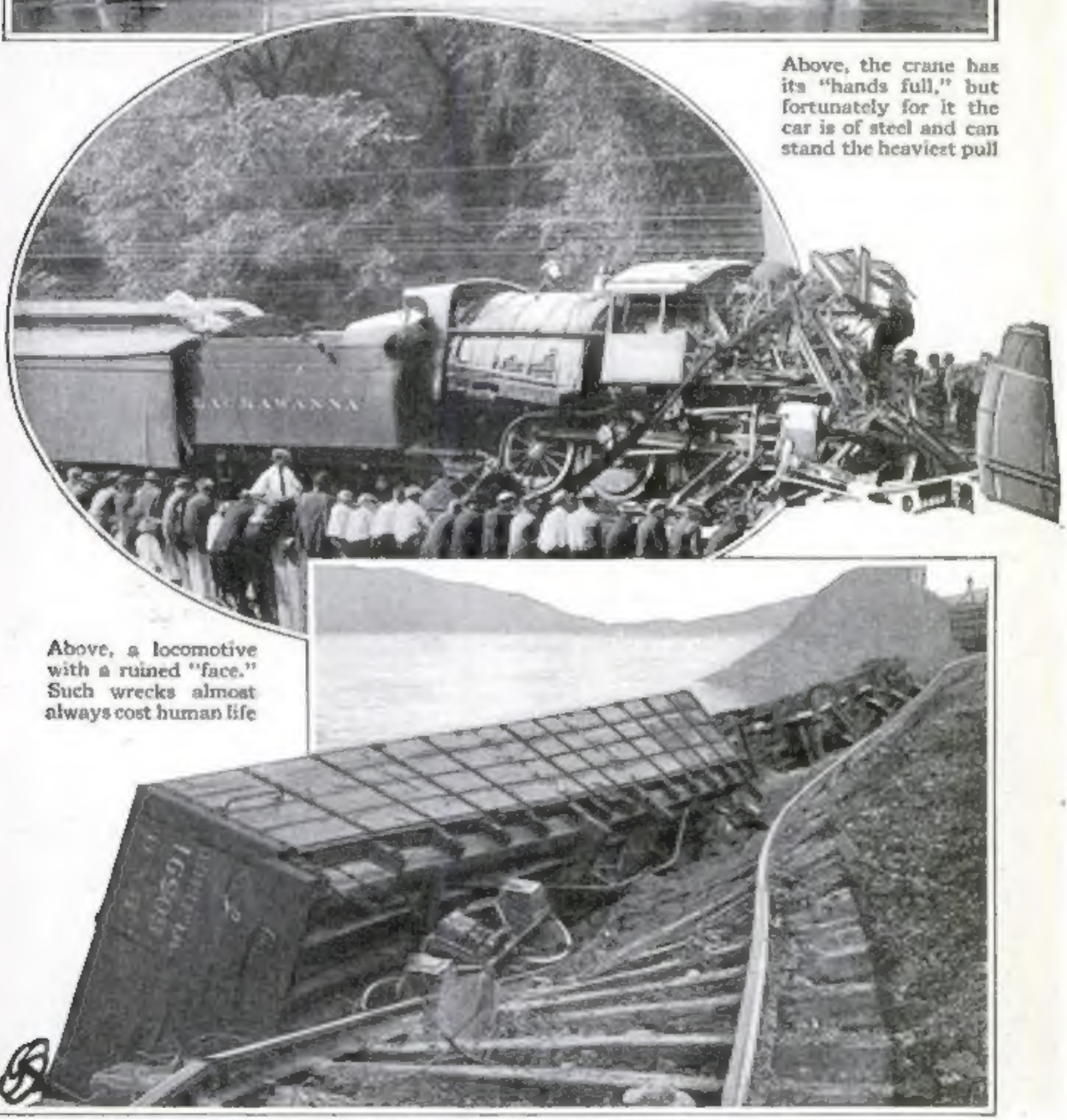
Sometimes the easiest way to clear the lines is to burn the wreck or blow it up. Track can be quickly relaid, if damaged, but nothing can replace lost time. The price of a cargo of automobiles is nothing against a five-hour delay. For the price of delay mounts in stunning geometrical progression. A few hundred dollars for the first hour, it may be many thousands of dollars in the second or third hour. A stoppage



A wooden coach stands at one side cut in two as if with a giant saw. Behind it stands an impatient express and behind that a long freight train. In the other direction a local is filled with fuming commuters and perhaps the President's special is close behind. All along the division and soon to spread through the whole system is delay, stalled trains, trains waiting orders, trains costing the railroad company thousands of dollars a minute to operate

The crane can pick up and transplant five tons of twisted steel as easily as a nurse can lift a baby from a perambulator. When the great tentacle-like hook descends, chains and ropes are brought into play, and slowly, surely, almost daintily, the crane swings the wreck to one side. If it cannot be lifted it is burned or blown up. The price of a cargo of automobiles is nothing compared with a five-hour delay or the disruption of a railroad's train schedule

Above, the crane has its "hands full," but fortunately for it the car is of steel and can stand the heaviest pull



Above, a locomotive with a ruined "face." Such wrecks almost always cost human life

A slip and slide into the river is all that happened here, but it took a complete track-laying gang in addition to the wrecking-crew to get the line open again and restore train schedules

The wreck occurred a considerable distance from this bridge but the threshing machine, mounted on a flat car, was hurled with such force that it struck the bridge and broke through

of the lines may mean a stoppage of the whole railway system, with hundreds of thousands of dollars worth of freight tied up, confusion, loss, waste.

And well he knows his work. The crane for this car, the jacks for that. This engine looks like scrap but will probably run; put her on the other track. That engine looks all right but is vitally wounded; throw her off. This car is too inextricably tangled with another in loving embrace to take to pieces, part by part; burn it up and throw the trucks to one side. The small man, a necessary factor, crawls into and out of openings and holes too small for his stronger mates, attaching chains and ropes, reporting conditions, doing work as valuable as that of the Hercules who, with a crowbar, heaves up a tangle of wheels that a jack may be slipped into position.

The doctors and the nurses and the relief-train have come and gone; down the line stands an impatient express, behind it a long freight. In the other direction, a local is filled with fuming commuters and perhaps the President's special is close behind. All along the division, and soon to spread through the whole system, is delay, stalled trains, trains waiting orders, trains costing the company thousands of dollars a minute.

Over the tangled debris one man stands supreme, snapping his orders like the crack of a whip, utterly unmindful of the property he destroys that other property may move. And, as if by magic, the lines clear. The last of the bent and broken cars are turned on their sides and slid down the bank. The injured engine limps off behind a fussy switch-engine sent for the purpose. If the delay looks long, a temporary side-track has been swiftly built and the several waiting trains puff slowly by. The wrecking-train whistles. Its crew, driving the last spike to make the injured track secure, pull out jimmy-pipes. The big crane folds its single arm and rests. The men pile into their caboose. The wreck is off the lines—time, fifty-five minutes. The wrecking-train has finished its work.

How the Porto Rican Does a Pushing Business

THE colored merchant of Porto Rico shown in this photograph may literally be said to do a "pushing business," for his stock in trade as well as his store itself is on wheels and is pushed about by the owner. Rent troubles this man not at all. If competition becomes too great in one spot he can readily seek a new location to solicit trade and he can go to his customers instead of his customers being obliged to come to him.

These quaint and curious stores on wheels are everywhere to be met with in Porto Rico. One sees them about the streets of San Juan and Ponce, in the suburbs of Santurce and Miramar they are legion, and one meets them along all the splendid automobile roads that stretch across the mountains and plains of the island. Even in the smallest and most remote villages and mountain towns the natives carry on their "pushing business" methods. The odd custom has much to recommend it aside from its picturesque and unusual aspects. The goods within—usually confections, cakes or other edibles—are carefully protected from flies, insects and dust. In a tropical climate this is of vast importance and in a country where sanitation is as strictly enforced as in Porto Rico it is entirely in keeping with the spirit of the people.

Many of the stores on wheels are very elaborate and ornamental, others show great ingenuity in their construction while still others are marvelous in their quaint architecture and gaudy colors. Some, like the one illustrated, are in the form of miniature buildings, others are in the shape of steamships or war vessels; others are fashioned like little trolley cars while some resemble nothing on the earth, in the heavens above or the waters beneath.

While his wife is wheeling the baby the Porto Rican is wheeling his business

An Air-Propelled Automobile for Three Dollars

AT an expense of three dollars Meredith Coates of Kansas City, Missouri, built an air-propelled automobile which ran at a speed of twenty-two miles an hour along a smooth road. The

This machine can go as fast on ice as on land. The only thing it can't do is fly

engine is a five-horsepower motor-cycle engine and it was bought for one dollar. The propeller was made from wood at a cost of another dollar and the last dollar was spent in making the gas-tank, boxings, steering-wheel, frame, shafts, pulleys and belt.

The apparatus was originally tried out on a canoe and then shifted to a sled. The sled runners may be seen attached to the frame in the accompanying illustration. When the ice was gone the propeller mechanism was transferred to the cart frame. The machine has all the appearance of a racing automobile.

The twelve pumps terminating in one large mixing tank are illustrated above. Each pipe is connected with a separate tank and the object of the apparatus is to obtain an accurate blend of the twelve different grades of oils

Blending Twelve Grades of Oil Into One

A PUMPING plant of a new kind has been constructed for a large oil company in the West to mix oils. There are twelve pumps, each of which is separately controlled by a clutch. Different grades of oils are required for various purposes, and it is the object of this equipment to supply the blends or mixtures of oils according to the formulas prepared by experts. Each of the twelve pumps is connected by a pipe with a different tank of oil, the main jet from all of them terminating in one large mixing tank.

Another Baseball Game in Disguise

IF baseball, the great American game, fails to live up to its reputation with the coming generation it will at least not sink into oblivion. The large and varied collection of games simulating it will serve to immortalize it to future residents of this world, and the historians of a million years hence will make mention of the fact that numerous game sets left behind by us lead them to believe that as a race we were a people of low mentality, worshipping a game called baseball with as much fervor as the ancient Egyptians worshipped their graven images.

The most recent addition to the collection of games which might puzzle our successors is an apparatus invented by a Massachusetts man. It has a game field provided with semi-conical catching-hoods arranged in the positions of the various players in the fields. These hoods serve to catch the ball and return it to a side pocket. There is a mechanical batter which swings a bat on a metal post set beside the home-plate. A spring operates the bat with considerable force.

The pitching device calls for real skill on the part of the player. The ball is pitched from a pivoted arm which has a ball-receiving cup at its upper end, and a notch in the rear of its base portion by which it is latched in retracted position. When the latch is released the pitching arm throws the ball toward the batter. The success of the player depends upon his ability to judge of the speed of the ball and then "bat" accordingly.

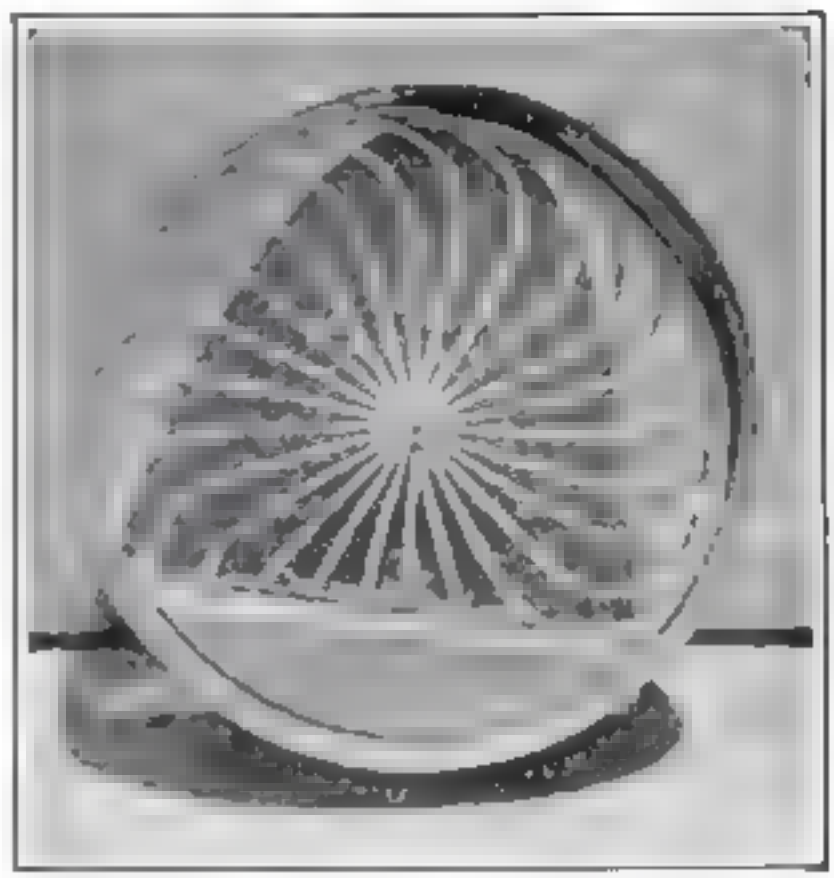
After considerable practice the player can sometimes "lift" a "high one" to center field or send a swift one bowling toward the shortstop position with such speed that it strikes the catching-hood with a resounding thud. This is one game where foul balls are unheard of. If the batted ball flies off at an angle the sides of the apparatus are high enough to prevent it leaving the board.

The baseball game outfit, showing the ball in position ready to be pitched from a pivoted arm to the mechanical batter which stands erect on home-plate

A Perfect Megaphone Shaped Like a Ram's Horn

A BOSTON physician, Dr. Edmund D. Spear, has invented a megaphone which is constructed on the theory that the original horn—the ram's horn—was and still is technically correct for sound reproduction. His megaphone is curved instead of the straight funnel-like shape of most other instruments, and one of the most interesting and useful features about it is the ability to use it without having it interfere with one's vision. Owing to the technical construction of the curved horn the volume of sound obtained is also much more satisfactory. In addition to this the tone is clearer and the enunciation more distinguishable. The best musical horns have the shape of a ram's horn.

The simple ram's horn is the original Adam of all our present-day megaphones



The ingenious water cooling and perfuming attachment for the electric fan

Perfuming and Cooling the Air with an Electric Fan

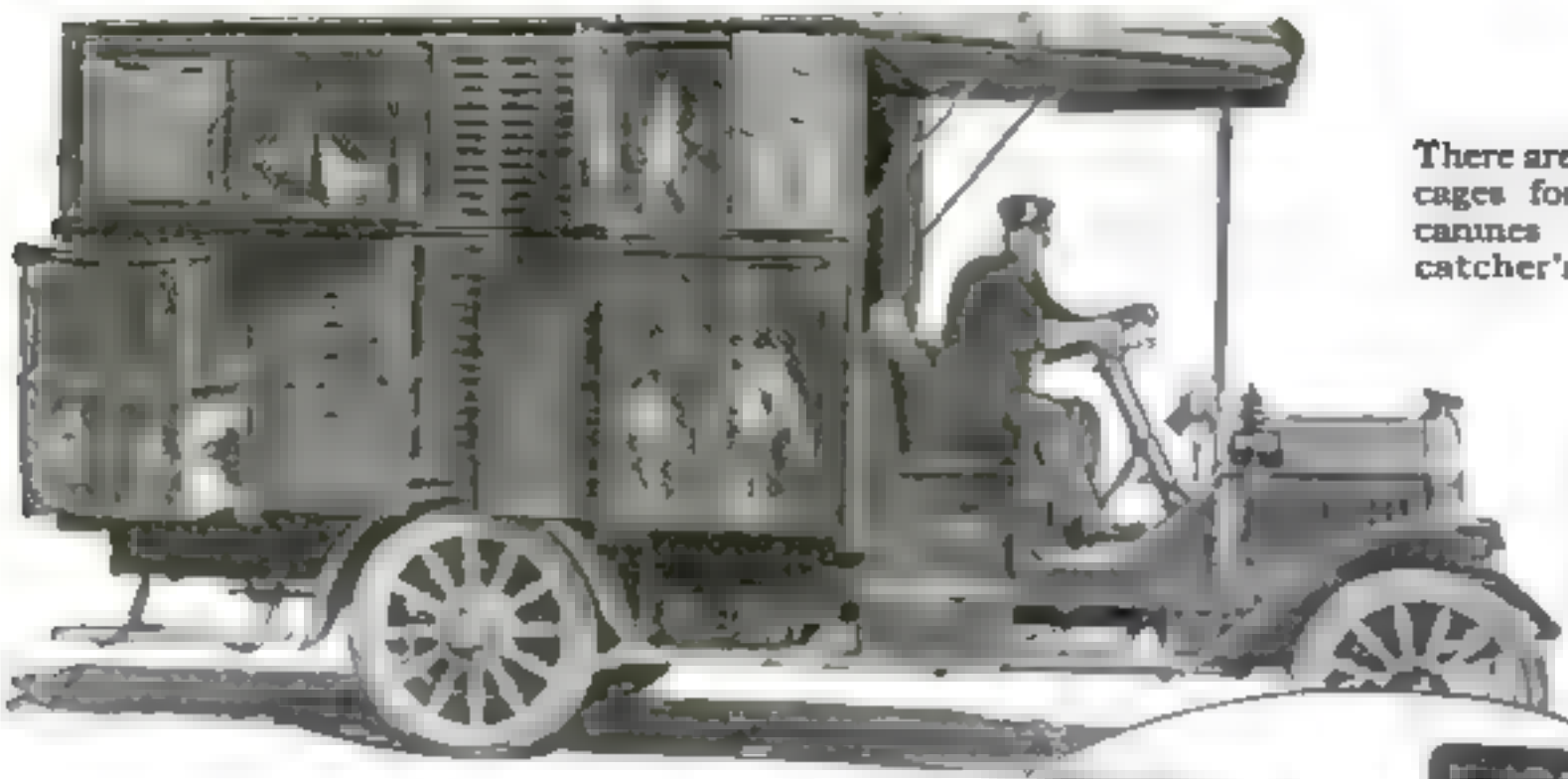
A CLEVER and useful attachment for the electric fan, designed by a Los Angeles inventor, consists of a tin wheel which can be hooked on any electric fan, and which will increase its cooling capacity many fold.

The spokes or propellers of this wheel are made of fine mesh screen. The lower part of the wheel whirls in a tank which is filled with cold water. The electric fan causes the screen propellers to revolve, and they dip into the little tank, throwing up a small amount of water on the upward turn.

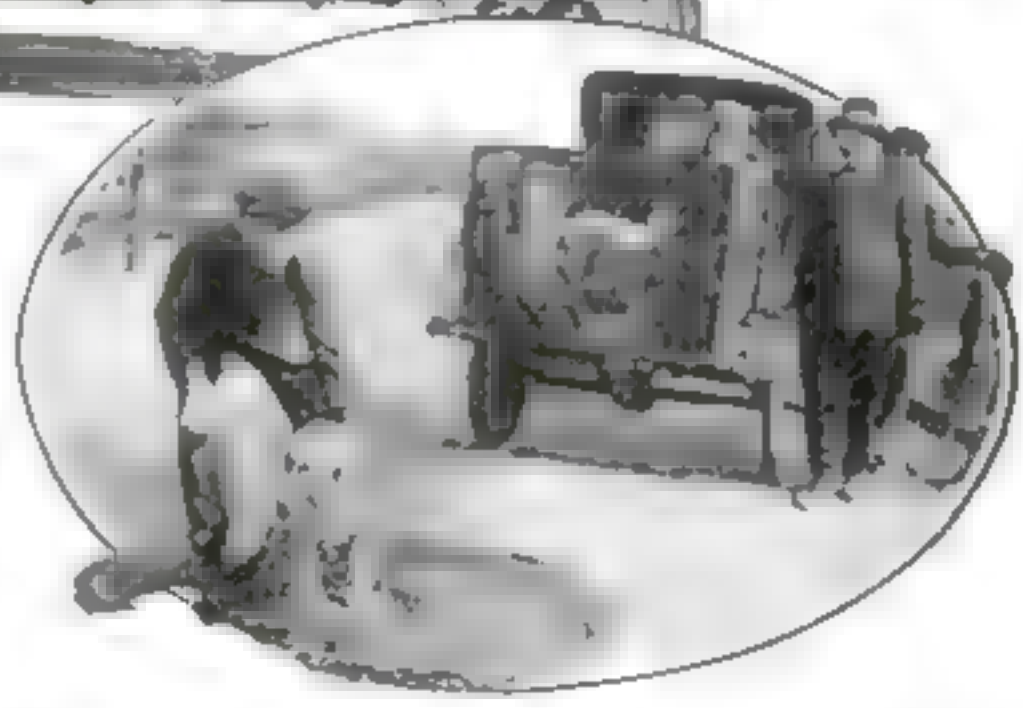
The air is sent through the water and is cooled, purified and cleaned. Perfume, a disinfectant, or a medicated liquid may be used instead of water.

Why the Gasoline Engine Keeps the Farmer Boy at Home

ONE of the jobs on the farm, which has had as much to do in creating the desire of the farmer boy to leave and go to the city, has been the chore of sawing wood. It is one job that seemed never to be ended. With the advent of the gasoline engine, the work of sawing the wood, not only for farm consumption but for commercial purposes, has been changed to one of great fascination, if not pleasure, in comparison with its former drudgery.



There are sixteen metal cages for all sizes of canines in this dog-catcher's automobile



Below, is shown the humane way in which a dog is caught by the wire net

Modern Dog-Catchers Use Motor Trucks and Wire Nets

KEEPING apace with the times, even the modern dog-catcher now uses motor-trucks to collect stray animals and haul them quickly to the pound. One of the latest types of dog-catcher's trucks is shown in the accompanying illustration It is used in one of the western cities and is equipped with an all-metal body for cleanliness. It is divided into eight compartments into which are slid sixteen metal cages to confine the dogs. The cages are pushed into place from both sides of the truck, meeting at the center. Four of the cages are subdivided into two parts each by horizontal partitions. These are used for the smaller animals while the remainder are employed for large dogs.

Each of the compartments has a shutter-door which protects the animals from the hot sun in the summer or snow in the winter and which gives them sufficient ventilation.

Motor-trucks have proven particularly adaptable for the dog-catcher because of the large growth of suburban territory about many of the big cities. This has necessitated longer hauls than horses could accomplish day in and day out through all kinds of weather.

Some dog-catchers prefer to use the wire net in catching the animals. This method is said to be far safer and surer than other methods in vogue, such as the wire noose and rope, both of which are more or less cruel. The catcher using the net merely throws it over the dog; the animal becomes entangled and is then placed in the wagon without further trouble.

The Cockroach Attracts Attention as a Trouble Maker

RECENTLY while inspecting a large plant attention was called to a peculiar incident. On a branch circuit there was some peculiar trouble. Fuses would blow out at various intervals running from one-half hour to twenty-four hours.

At first no attention was paid, but when the ground detector started to show signs of trouble, first on one side and then the other, an investigation was made. Covers were removed from the outlet boxes and from one box a shower of live and dead cockroaches fell on the head of the examiner. On looking into the box, it was found that the insulation around the joints and especially at the points had been entirely eaten away, the vibration of the building doing the rest toward creating the trouble.

The King of New York's Lighting Spectacles

FRAMED by the masonry portals of the Municipal Building the Woolworth tower by night represents one of the greatest artistic achievements in this age of electrical wonders. For more than a year now the thirty-storied tower has burst out into the night as a giant shaft crowned with a scintillating jewel. When that part of the building below the thirtieth floor is dark the tower takes on the appearance of a huge crystal hung by invisible wires from the skies. When the switches are pressed into sockets illuminating the structure more current is employed than is necessary to light the streets of a city of thirty thousand inhabitants. Six hundred automobile lamps are contained in the electrical installation.

The lights are so arranged that they flood every inch of the structure. An ingenious system of screening prevents the rays from shooting directly downward or upward, thus revealing the source of light. Anyone viewing the spectacle from below is vexed to find where the light comes from.

Photo by Levick

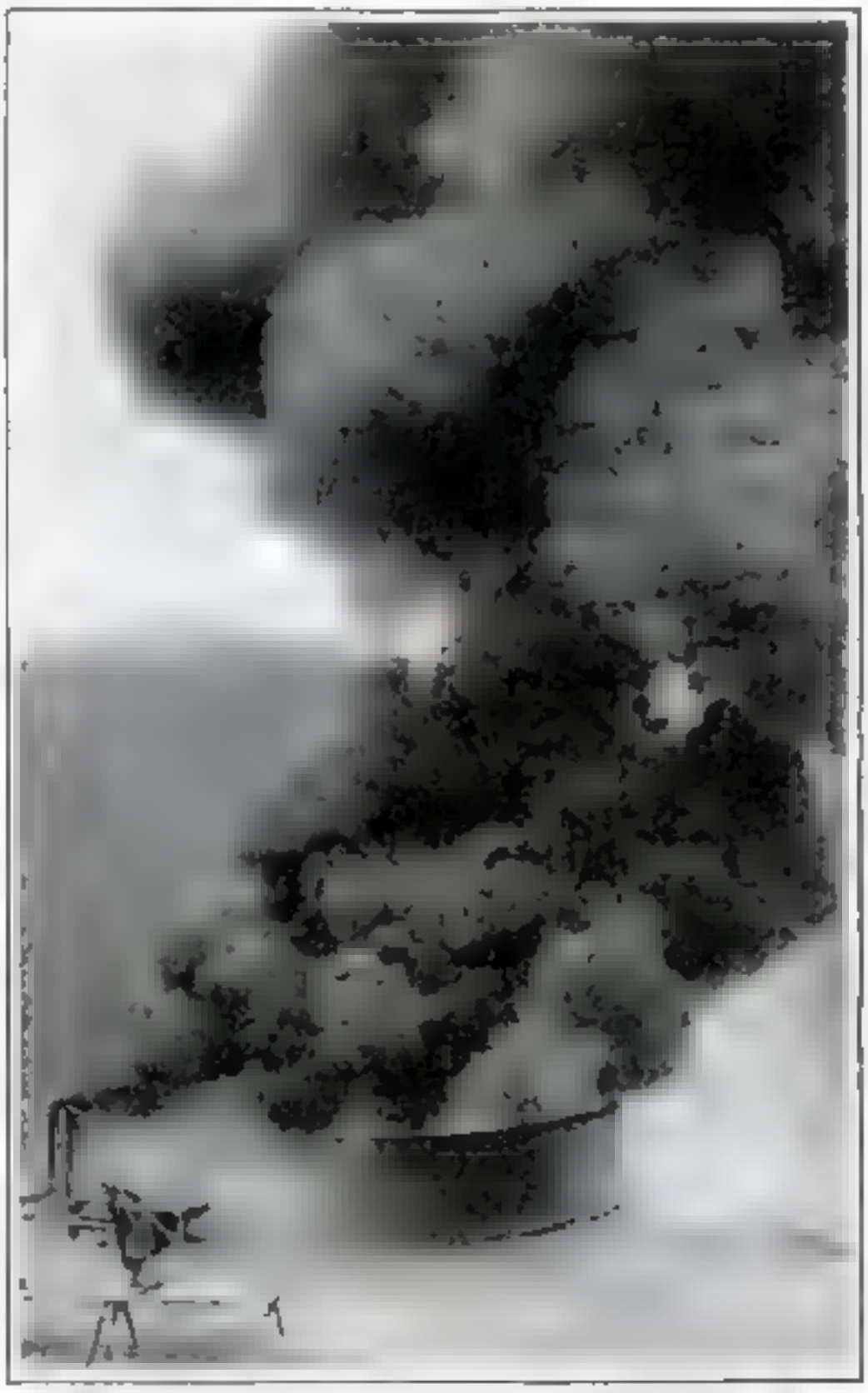
The Woolworth tower is the king of New York's skyline at night. Its crown is a great scintillating jewel

Origin of Gas Jets Traced to Woman's Thimble

A WOMAN'S thimble is said to have been the means of suggesting the first gas burner. William Murdock, the inventor, first burned the gas simply as a flame from the end of a pipe. One day in an emergency he wished to stop the illumination. Hurriedly looking around for something, Murdock seized his wife's thimble and thrust it over the light, which was immediately extinguished. There was a strong odor of gas, however, and the experimenter applied a light to the thimble, discovering that it was full of holes, through which tiny jets of flame appeared. The importance of the result was that the illumination from those two or three tiny jets was much brighter than had been given by the great flare from the end of the pipe. Acting on the principle which this chance discovery revealed, he constructed what was known as the Cockspur burner.

Extinguishing an Oil Fire with Carbon-Dioxide Foam

FIFTEEN thousand gallons of gasoline were set on fire recently at the Greenpoint plant of the Standard Oil Company to test carbon-dioxide foam as an extinguishing compound. The oil was allowed to burn for about a minute during which time the flames and smoke gained such headway that a column of it mounted three hundred feet in the air. At this point the carbon-dioxide foam was turned on, and it was so effective that the fire was within control in a very few seconds and entirely out within forty-four seconds.



The oil was allowed to burn for a minute when the carbon-dioxide foam was forced into the blaze from the pipe which is shown at the left of the picture

Most of the big oil tanks of the country are now protected by an automatic device which releases carbon-dioxide foam in quantities sufficient to put out the biggest fire. Where a tank explodes, however, other measures have to be taken. Sand is most frequently used in these emergencies, and water, used in the early days of oil fire-fighting, is now never used, since it is heavier than oil and causes the gasoline to overflow and thus spread the fire instead of confining it.

Where vats of highly inflammable liquids such as benzine, naphtha and kerosene are stored, they are equipped with pipes so that they can be drained.

Locating Guns by Delicate Earthquake-Detectors

SCIENCE has discovered that gunfire affects the earth's surface much like an earthquake, so it is not surprising to learn that guns are being located by the seismograph—the delicate little instrument which records terrestrial tremors. An Austrian authority on the subject of earthquake disturbances announces that the seismograph can record the position of hostile artillery as well as the caliber of the guns.

In the fairly recent engagement between Italian and Austrian troops at Isonzo, the tremors induced by the heavy cannonade were duly registered by the apparatus, and the operator was able to detect, by means of diagrams of artificial movements of the ground, the difference between the shocks produced by the fall of projectiles and those caused by the recoil of the guns. Moreover, the form of the tracings revealed to the practiced eye the number as well as the caliber of the latter. From these results came the suggestion that movable seismographic stations ten to twelve miles in the rear of the trenches and connected with them by telephone would enable trained observers to transmit information to the commanding officer.

Signal detachment, with flags and telephones, fording a river to lay a line of communications

Throwing a Line of Communications Across a River

WHEN an army invades a country the most important thing after digging itself into the ground is to establish a line of communications. This duty devolves upon the signal corps. In the photograph reproduced above a detachment of our signal corps is shown advancing across a river with signal flags and a portable field-telephone equipment. By means of the flags they wig-wag their position to the forces in the rear which are protecting them. When the telephone line is completed it affords communication between the first-line troops and the ones behind, and between the commander and the heads of separate divisions.

Blow-Pipes of the Borneo Land Dyaks

ALTHOUGH one of the simplest of weapons the blow-pipe used by the Land Dyaks of Sarawak, North Borneo, requires more skill in the making than any other instrument or implement of a primitive people.

No thin sapling sufficiently straight or strong for a blow-pipe is to be found in the forests of Borneo, so the laborious method of working down a large piece of wood has to be resorted to. The wood most favored is called *yong* by the natives. It is heavier than water and of very tough texture, but it is fairly easily worked, even after a couple of years' seasoning. The *yong* log is rigged up vertically in a scaffolding, and almost on a level with the upper end of it is a platform upon which the driller stands. The task of the latter is to run a perfectly straight hole three-eighths of an inch in diameter through the whole length of the log.

As the hole deepens, longer handles are attached to the chisel blade, the last being as long as the log itself. The driller is invariably an old man, with years of experience behind him as a driller's apprentice. Considering his long training the accuracy of his work is remarkable. Only after the hole is completed, tested, and found true, is the less careful but still laborious work of shaping down the outside of the log taken up. This is done first with axes, then with the parang or native knife, and finally by scraping.

The dart of the Dyak blow-pipe is of some light wood—pith is sometimes used for short range work—and the tip is of bone, or steel. Where the latter is obtainable small birds can be brought down by the dart alone.

The Dyak blow-pipe requires infinite skill in working it down from a log

SUBMARINE DESTROYERS

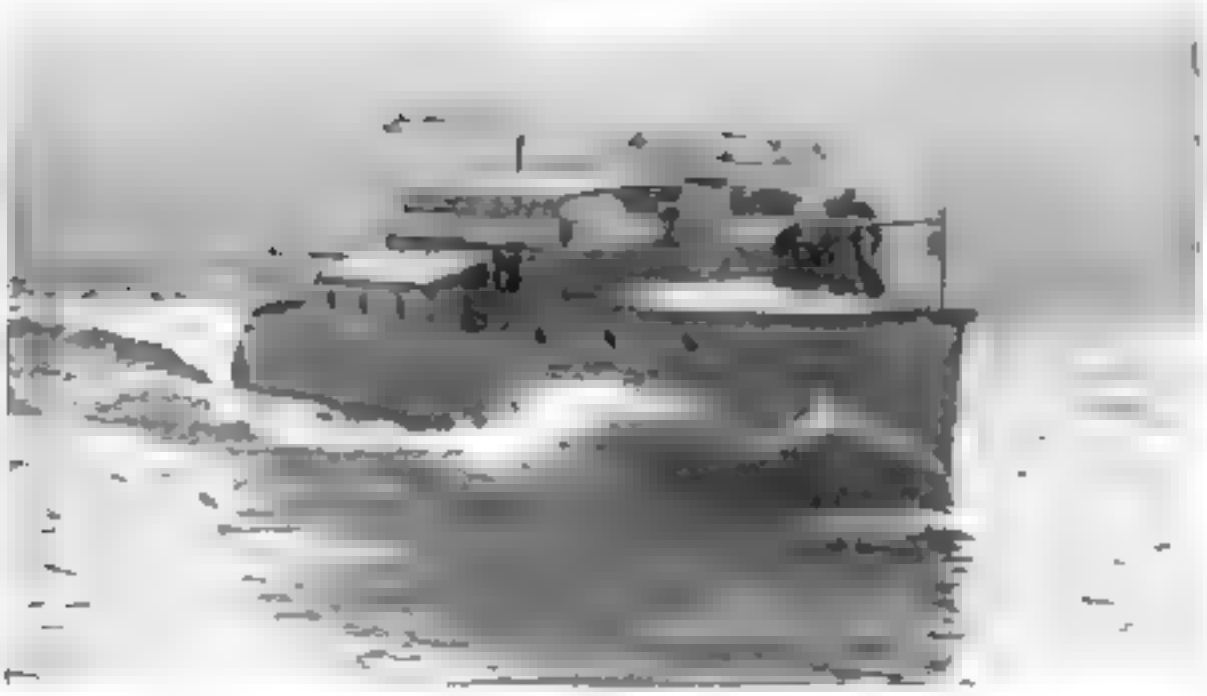
A new use for motor boats

SKIPPERS sleep peacefully in their berths on the freighters lying in the Thames near London in spite of submarine warfare. Freight from America and other countries, munitions of war and food supplies, arrive there in such quantities that the boats cannot be unloaded immediately, but they are just as safe in the mouth of the Thames as they would be in New York harbor. For that, England has America and Russia to thank. Some enterprising Russian must have seen Flyaway III winning races in American waters; there is the secret of the safety of commerce in the mouth of the Thames.

What keeps the German submarine away is the huge fleet of pert, saucy, little American launches. All of them were developed from the lines of Flyaway III, one of the few new engines of war for which America is responsible. Each boat is sixty feet long and is driven thirty miles an hour by gasoline engines. "Submarine swatters," the boys down on Long Island, New York, nicknamed them before they were shipped. With supplies of food and fuel for several days' cruise these boats spread fanlike from the mouth of the Thames, and from other shipping centers in England and Russia on the lookout for the wily submarine whose evil eye trails a tail of oil and bubbles behind it. In the deck house of the submarine swatter is a three-pound quick firer, capable of knocking the periscope clean off, or mortally wounding the submarine before it can come to the surface and get into action against the little American launches. No submarine can sail any waters where these fleets are located for half a day without being spotted, trailed, and destroyed. As was said before, the skippers of the freighters in the mouth of the Thames, waiting for a chance to unload, sleep peacefully on.

A trial order of these submarine swatters was given to a Greenport, L. I., construction company late last year, and

The motor-boat, up to this year considered insignificant in warfare, is proving to be the submarine's livest foe. Its powerful engine gives it speed and a wide radius of action



It looks like a peaceful, dumpy affair, but it can squirt death

shortly afterward six were shipped to Archangel, before that Russian port closed for the winter. Great secrecy was maintained as to the details, but after the second order was given, proving in the only way possible that the boats were successful, general specifications were admitted.

Each boat carries three 175-horsepower engines, giving a total of 525 horsepower to drive the load. The speed called for was twenty-six miles an hour, but the average, on the trials which could be held, was over thirty miles. The boats are sixty feet long, ten feet beam, and two feet ten inches draft. They weigh twenty-eight thousand pounds. There are accommodations for eight men, six bunks forward and two aft, the latter for the engineers. The pilot house, which is practically the only obstruction on the deck, is armored and has room for a quick firer, which of course was not mounted before the boats were shipped to Russia.

The boats are of the V-type, a design which is but a year or two old in American motor-boats. The bow is sharp, but a few feet back is a shoulder on each side of the hull, which performs the same duty as the steps on a hydroplane, and lifts the hull partly out of the water. The first large boat of this design which was completely successful was the famous champion racing cruiser Flyaway III, which is still champion. Were the new Russian submarine swatters to compete with Flyaway, a new winner would probably be announced. They are much larger, faster boats, in fact, the largest V-type ever constructed, and it is the success of this development which has so interested Americans.

As fighters, these motor-boats should be efficacious against submarines. They draw so little water that they can ride safely over the ordinary mine-fields without exploding the mines. They are equipped with two rudders so that they

Equipped with wireless it cuts through the water and rides safely over mine fields

can turn completely around in a little more than their own length, and hence can steer a violent zig-zag course. A submarine attempting to torpedo such a boat, traveling thirty miles an hour with so little hull to shoot at, would be attempting almost the impossible.

In realizing the tremendous advance of the motor-boat it must be remembered that these vessels can travel at high speeds, in almost any seaway, carrying eight men for long distances, and that they are armed in addition. A few years ago motor-boats did not travel so fast with one man, for a mile only, even on quiet, inland waters. And yet they are small enough to be placed on the deck of a warship. This is evidenced by the fact that each is equipped with cleats, bolted to the keel, by which it can be lifted from the water. This is the reason England has placed a very large order for duplicates of this American design.

Hitching the Mower to the Farm Automobile

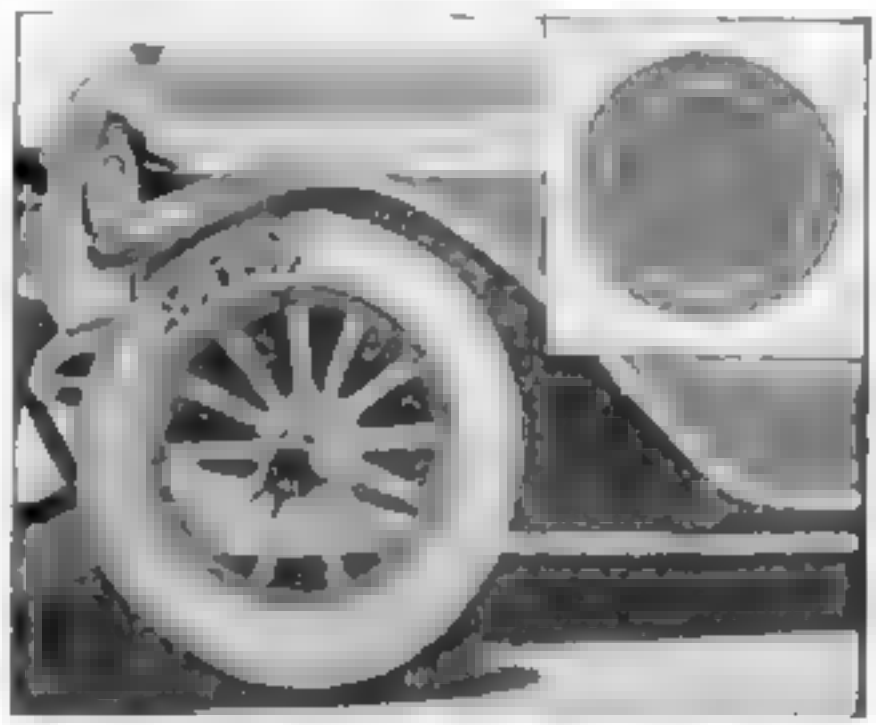
A CALIFORNIA ranchman (James M. Berry, Sacramento) found that pea vines came up so thickly in a grain field that it was impossible to cut the grain. He decided therefore to cut it for hay. Because of the shortage of horses he tried hitching the mower behind the ranch automobile. The plan worked so successfully that about twenty acres were cut each day, the car drawing the mower at such speed that the mower readily cleared itself. When horses were used, the blade frequently clogged itself.

The hay was raked by the same method. In the fall the automobile was used to run a stacker. The lift rope of the stacker was attached to the front axle of the car and when the operator desired to raise the load of hay he would back the automobile until the stacker had cleared itself. Then it would be lowered by reversing the machine, letting it down gently, whereas horses would jerk the stacker and let it down abruptly, with a bump.

The farm automobile took the place of horses and did the big job better and in less time

The Reinforced Concrete Principle Applied to Automobile Tires

A NEW tire has been patented which combines elasticity with great durability. The principle is similar to that employed in reinforced concrete; a woven fabric is embedded in a body of elastic composition.



A portion of the tire with the "shoe" cut away, showing the reed woven into a network of strands

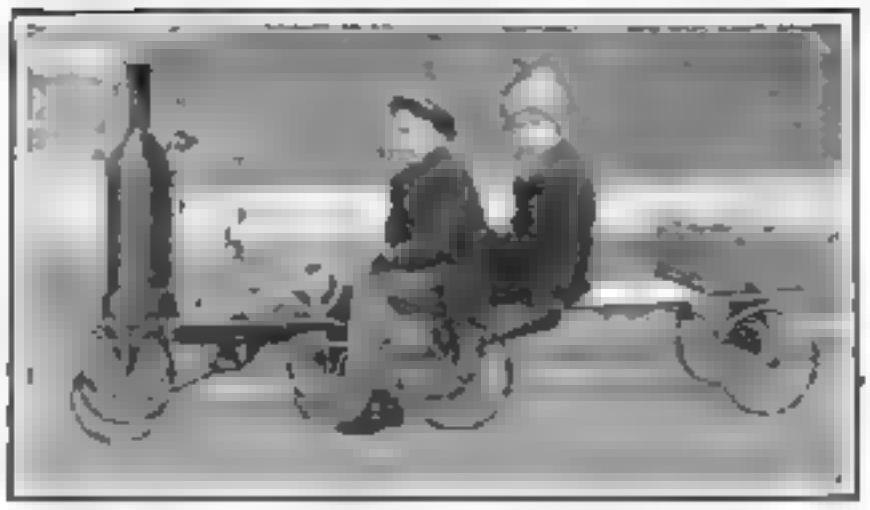
Vegetable reed, preferably "Spanish cane," is woven into a network of circular and longitudinal strands. There may be one or several tube-like arrangements, or a spiral effect may be used. The spans between the fibers are filled with a substance which can be poured in when hot and allowed to solidify. This composition is highly elastic and yet is strong enough to resist road bruises.

Its main advantage over the solid rubber tire is its elasticity and durability No road is too rough for it and it will bear up under the hardest service. The "Spanish cane" adds greatly to its wearing qualities in all sorts of weather.

Boy's Road Wagon is a Real Locomotive

A MECHANIC in a garage machine-shop in Eugene, Oregon, wanted his boy to know something about the mechanics of a locomotive, and in his spare moments constructed the machine in the accompanying illustration. It is a perfect miniature of a large steam engine, and is complete in every detail. It carries a pressure of steam up to forty-five pounds, and pulls the tractor with two passengers at a speed equal to a fast walking gait.

The engineer and owner is a boy nine years old, and he has already obtained a remarkable knowledge of the actual working of a steam locomotive from the operation of his little machine. The engine burns coal, pitch-knots, and small pieces of bark and wood.



The locomotive with the engineer in overalls and his trusty fireman behind him

A Cane to Help the Convalescent Soldier

A CANE intended to make walking easier for the convalescent soldier has found popularity in England where every ship from the war zone brings wounded men still too weak to walk great distances but sufficiently recovered to be about. It is of stout construction. It has a curved handle and is fitted with a rubber tip so that it is a safe support when traversing slippery pavements. The unique feature of its construction is a folding foot-support which opens on the principle of a knife-blade, a few inches from the bottom. This the soldier uses as a rest.

How the cane foot support assists the soldier in walking

Wind Cave Excels Mammoth Cave

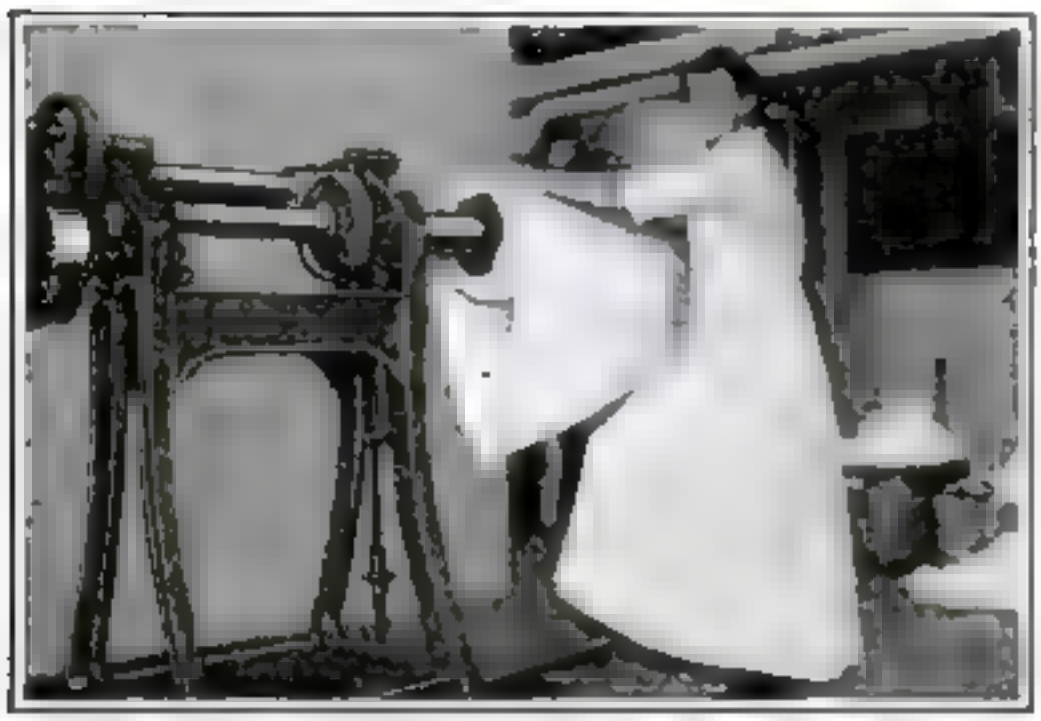
WIND CAVE, National Park, in the Black Hills, about twelve miles from Hot Springs, is on the Deadwood-Denver scenic highway—the "Triangle D" road of the West.

Wind Cave enthusiasts claim that this cavern excels the Mammoth Cave of Kentucky in splendors and in extent. Half a dozen government surveys have been made in the park. These and various private exploring expeditions that have been organized have accounted for some 96 miles of the recesses of Wind Cave, but there are hundreds of passageways that have never been explored. No one knows to what depths they lead, or how far under the Black Hills they may take the explorer.

The average visitor to Wind Cave, National Park, travels from six to ten miles underground and comes forth into the daylight realizing that he had seen but a small fraction of this great cavern.

Wind Cave takes its name from the strong current of air which almost constantly surges in or out of the entrance. It is said that this led to the discovery of the cave in 1881.

Many explanations as to this mysterious rush of air at the entrance to Wind Cave have been advanced. Some have claimed that the rise and fall of mysterious lakes, many hundreds of feet underground, where no exploring party has yet penetrated, are the cause of these air currents. A more generally accepted theory, however, is that the air pressure outside is the cause of it all. The cave is a huge barometer, responding to every change.



The skirt is guided by the two hands and the machine operated by treadle, to obviate all danger

At Last! a Machine Which Irons Skirts Without a Murmur

AMONG the latest of labor saving devices is a skirt ironing-machine invented by a Troy, New York, man. The skirt to be ironed is placed over a big conical roller. The ironing member is a hollow structure that fits over the conical roller and is supplied with steam to do the ironing. The conical roller over which the skirt is placed is operatively connected with a treadle, which when depressed raises the roller so that the ironer presses the garment.

An Air-Tight Compartment for Canoe Campers

FOR the convenience and safety of canoeists an improved form of air and water-tight compartment or locker has been invented. It not only affords a storage place for food and sufficient equipment for a small camping trip, but also provides a buoyant means for the canoe should it upset.

The metallic locker fits snugly into the forward end of the canoe. All seams are made water and air-tight, and a circular opening, fitted with a water-tight cap, is provided through which food, clothing, ammunition or other supplies may be placed without fear of them getting wet. The locker is bolted to the canoe frame, and a padlock and chain prevents the cap from being removed.

Soldier of Today Better Off Amid New Horrors

THOSE who argue that the horrors of applied science exceed its blessings are ignorant of the soldier's life. The soldier in to-day's war is infinitely better off amid all his new horrors than was the soldier of yesterday. The man in the trench is "the darling of time." Death stares him in the face, but a thousand hands are stretched forth by science to snatch him from those jaws.

In the words of Sir William Osler: "What shall be our final judgment—for or against science? War is more terrible, more devastating, more brutal, and the organization of the forces of Nature has enabled man to wage it on a titanic scale. More men will be engaged and more will be killed and wounded in a couple of years than in all the wars of the previous century.

"To humanity in the gross she seems a monster; but on the other side is a great credit balance—the enormous number spared the misery of sickness, the unspeakable tortures saved by anesthesia, the more prompt care of the wounded, the better surgical technique, the lessened time in convalescence, the whole organization of nursing:

"The wounded soldier would throw his sword into the scale for science—and he is right."

The air-tight locker is a storage place for a camping equipment and also prevents the canoe from sinking

Accelerating the Fruit-Picker with a Picking Harness

THE fruit-picker who has long put up with the inconveniences connected with picking fruit from trees will welcome the appearance of a picking harness. The harness consists of broad straps or suspenders to which the fruit basket or pail is hung in front, leaving the hands free for picking.

Equipped with it the picker goes about his task with ease, placing the fruit in the receptacle in front of him. He does not need to worry about its getting away from him, as the old pail hanging on the tree-branch often did, and he can strip a tree clean of its fruit in much less time with the new harness. In the berry season the harness can be used to advantage, and it is a great improvement for all workers in the orchard.

This harness is light and enables the fruit-picker to work with both arms

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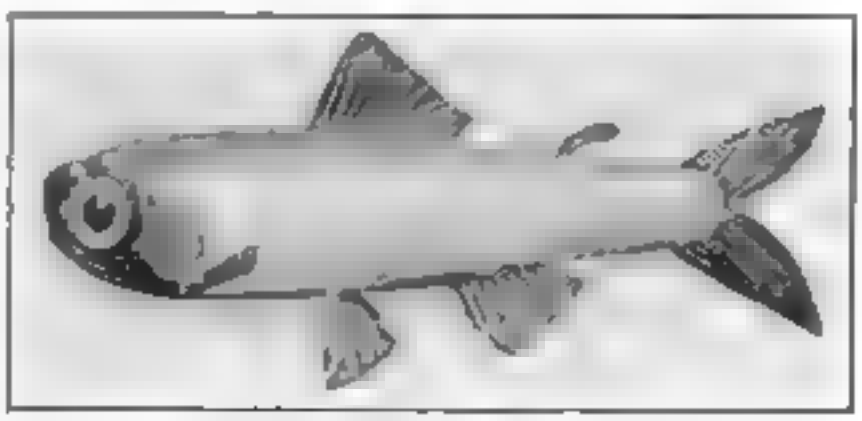
A Deep-Sea Fish Which Has a Lantern of Its Own

AMONG the most remarkable fishes are those provided with lanterns of their own, and which swim in the dark recesses of the bottom of the deep ocean where no ray of natural light from above can penetrate. A model of one of these fishes, notable for its phosphorescent organs, is on exhibition in the United States National Museum. The sides of the fish are dotted at regular intervals with luminous spots, which may be seen in the illustration. In addition there is a large luminous area like a lantern on the top of the head. This extraordinary creature must present a singular appearance when swimming in the dark abysses of the ocean. In the model the luminous spots on the sides are represented by buttons of glass connected with the interior by tubes. The luminous protuberance on the head was modeled in gelatine and then tinted. When in operation the model is connected with electric current so that a distinct glow appearing in the side spots and the frontal "lantern" produces a very striking and, it is believed by fish experts, a quite accurate representation of the appearance of a living phosphorescent deep-sea fish. The model is about a foot long.



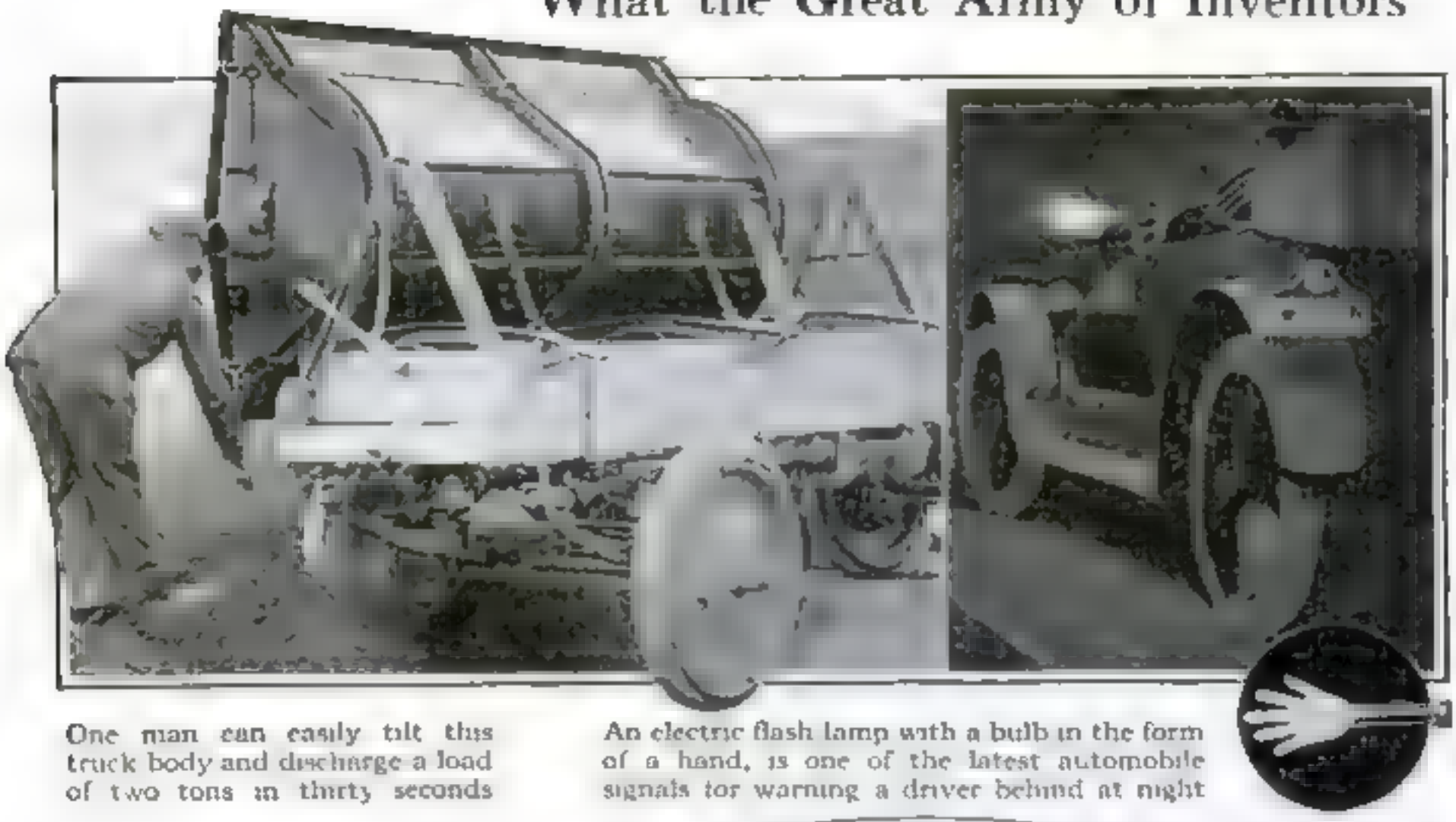
The luminous spots are represented by buttons of glass which light periodically

A Sailor's Nautical Wind-Wheel

A NOVEL wind-wheel which gives the effect, even in a light breeze, of two sailboats pursuing each other in a circle can be constructed easily and will prove a source of considerable amusement to children. Through the center of a strip of wood a yard in length, no wider than one inch and no thicker than one-half inch, a nail is driven which serves as a pivot. At either end of the stick a miniature sailboat is mounted.

The boats should measure about twelve inches in length, with a tapering bow and stern which may be whittled or sawed. A mast is mounted in the bow of each, and a triangular cloth-sail tacked or sewed in place. For a ship-shape wind-wheel, the sail may be stiffened with a sturdy boom.

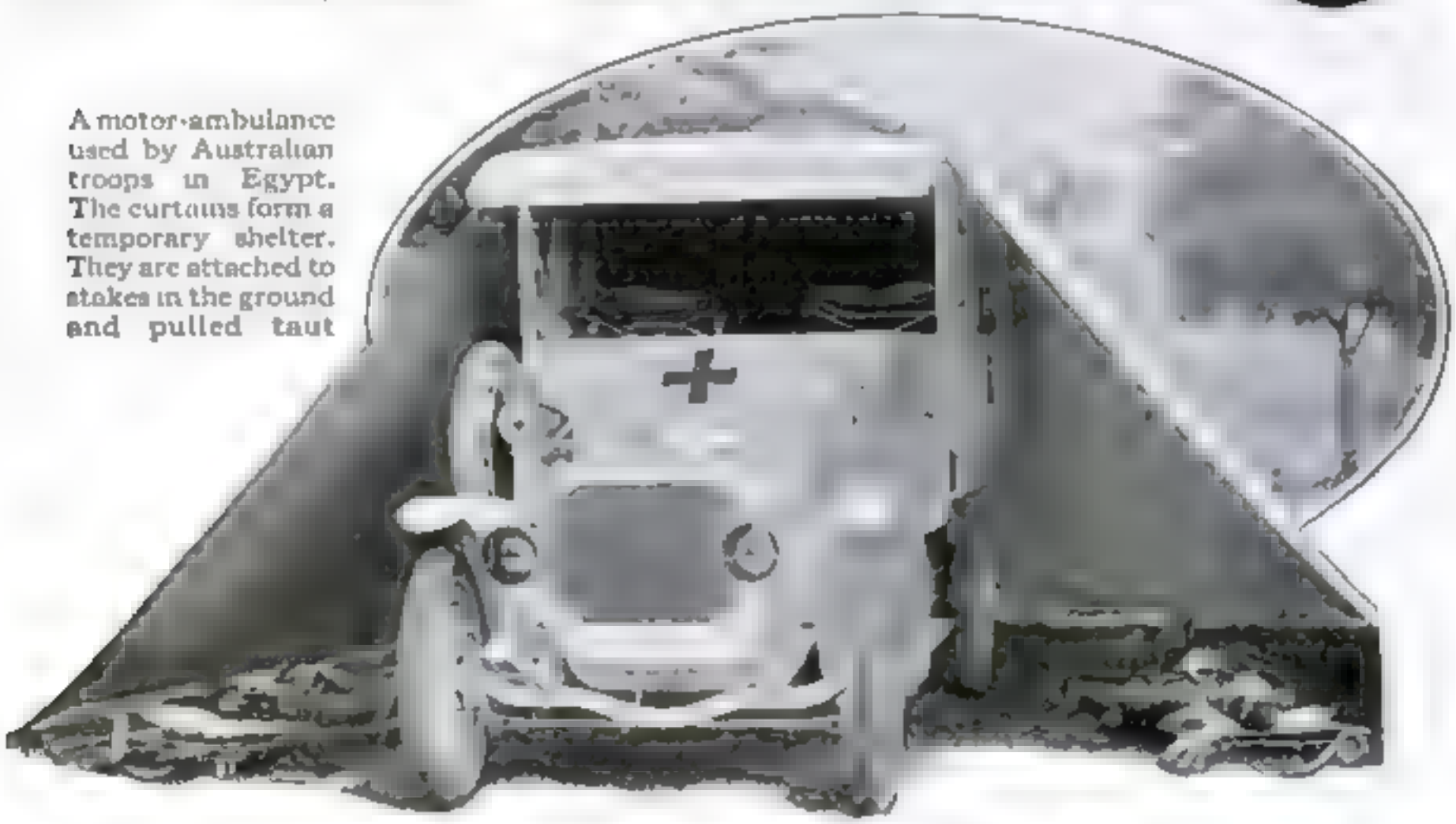
What the Great Army of Inventors

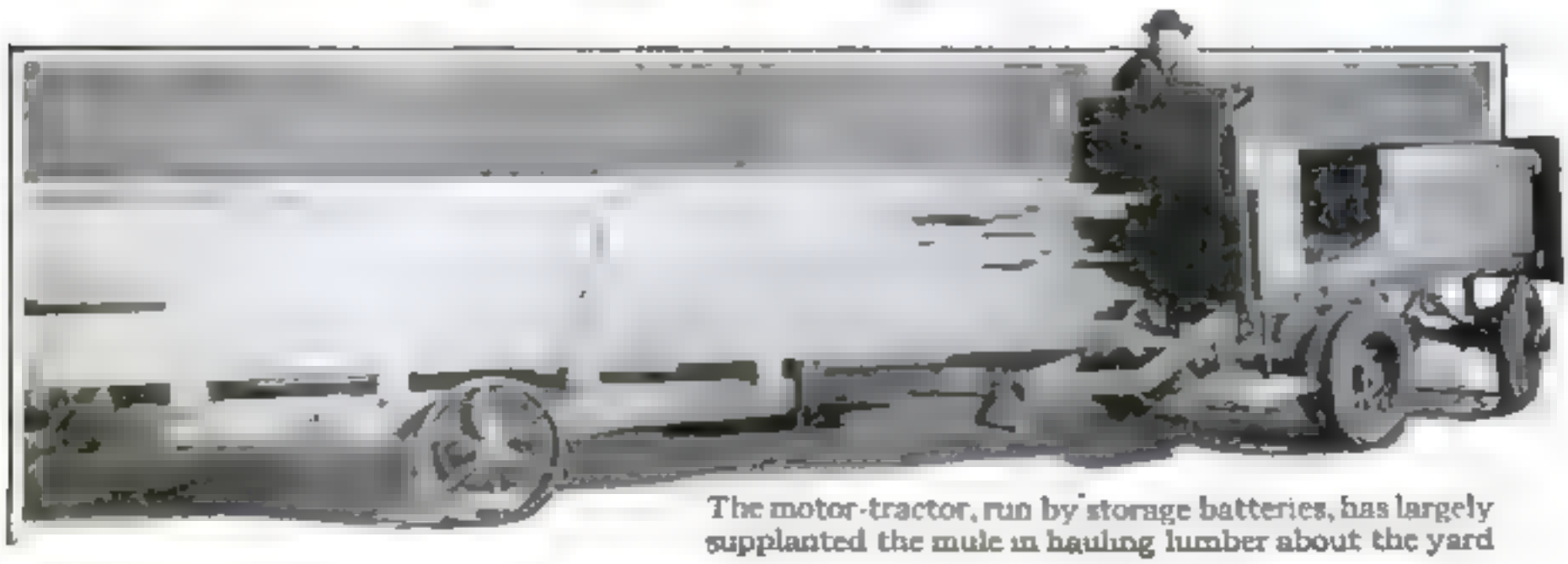


One man can easily tilt this truck body and discharge a load of two tons in thirty seconds

An electric flash lamp with a bulb in the form of a hand, is one of the latest automobile signals for warning a driver behind at night

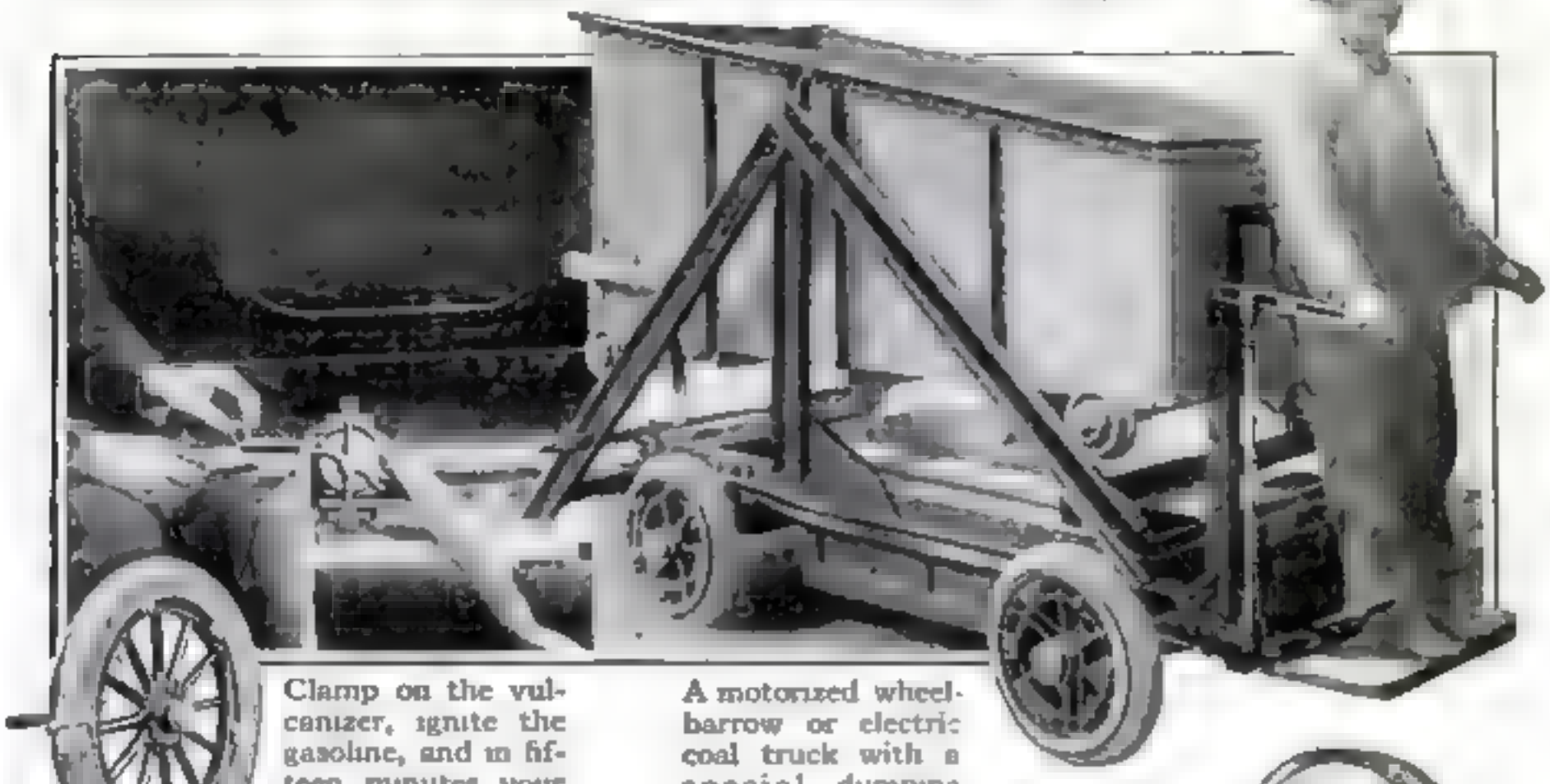
A motor-ambulance used by Australian troops in Egypt. The curtains form a temporary shelter. They are attached to stakes in the ground and pulled taut





The motor-tractor, run by storage batteries, has largely supplanted the mule in hauling lumber about the yard

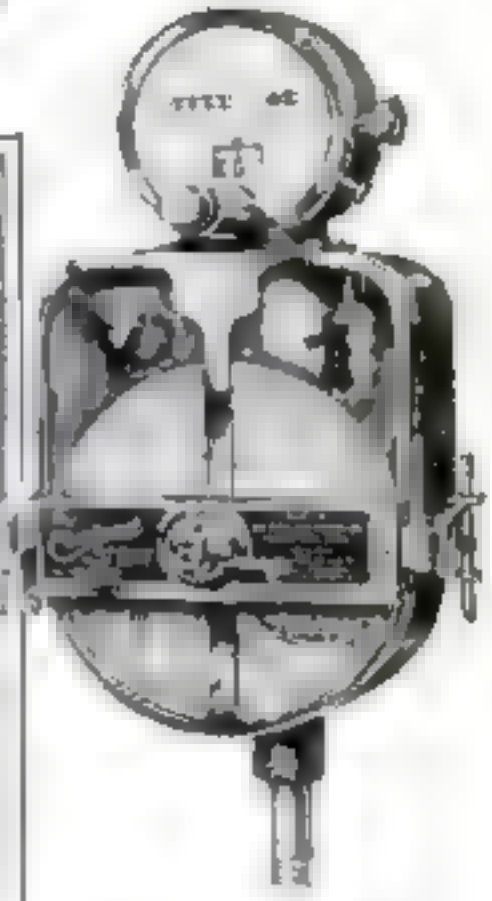
Are Doing to Make this a Horseless Age



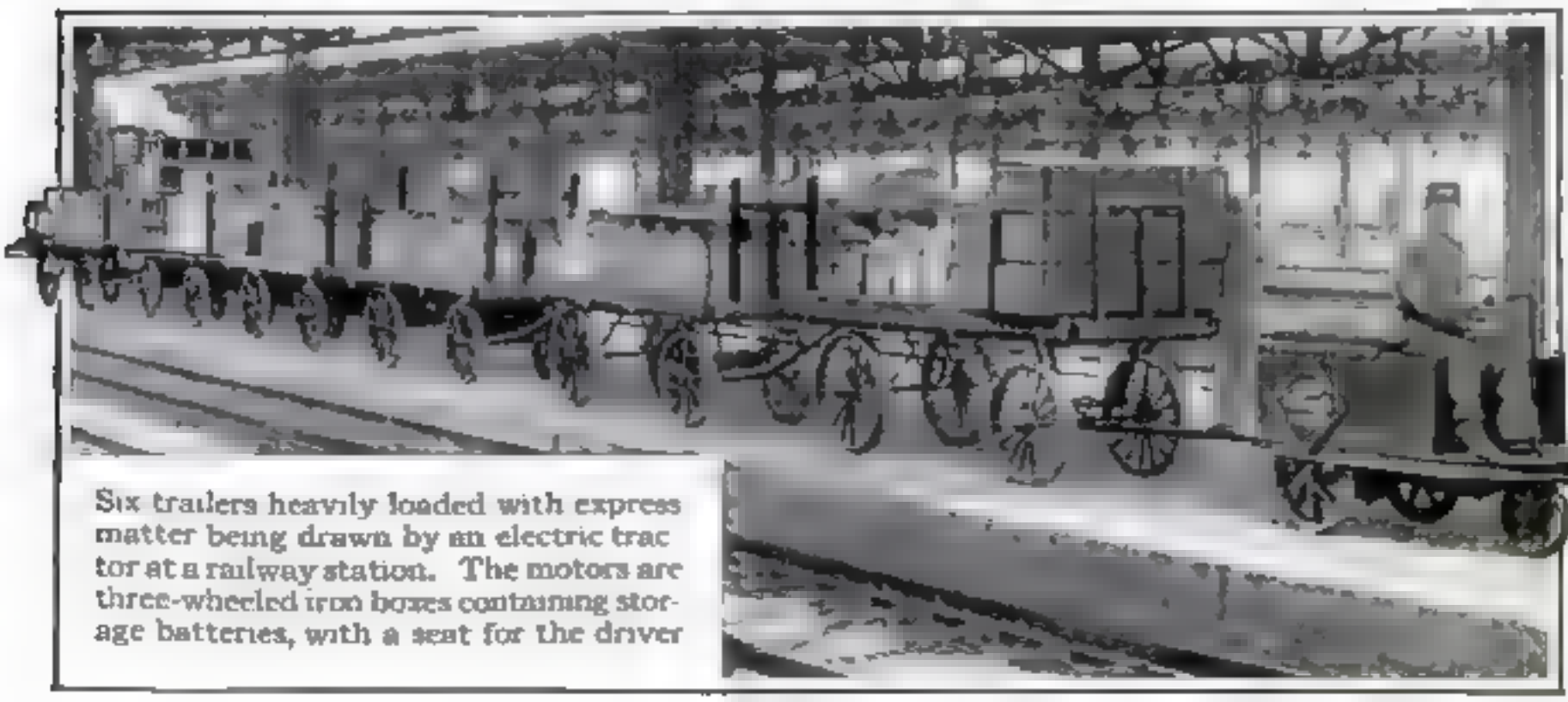
Clamp on the vulcanizer, ignite the gasoline, and in fifteen minutes your tire is as good as new

A motorized wheelbarrow or electric coal truck with a special dumping mechanism

A motor-bus as luxurious as any limousine, used by a hotel in Winnipeg, Canada, to carry passengers to and from the station



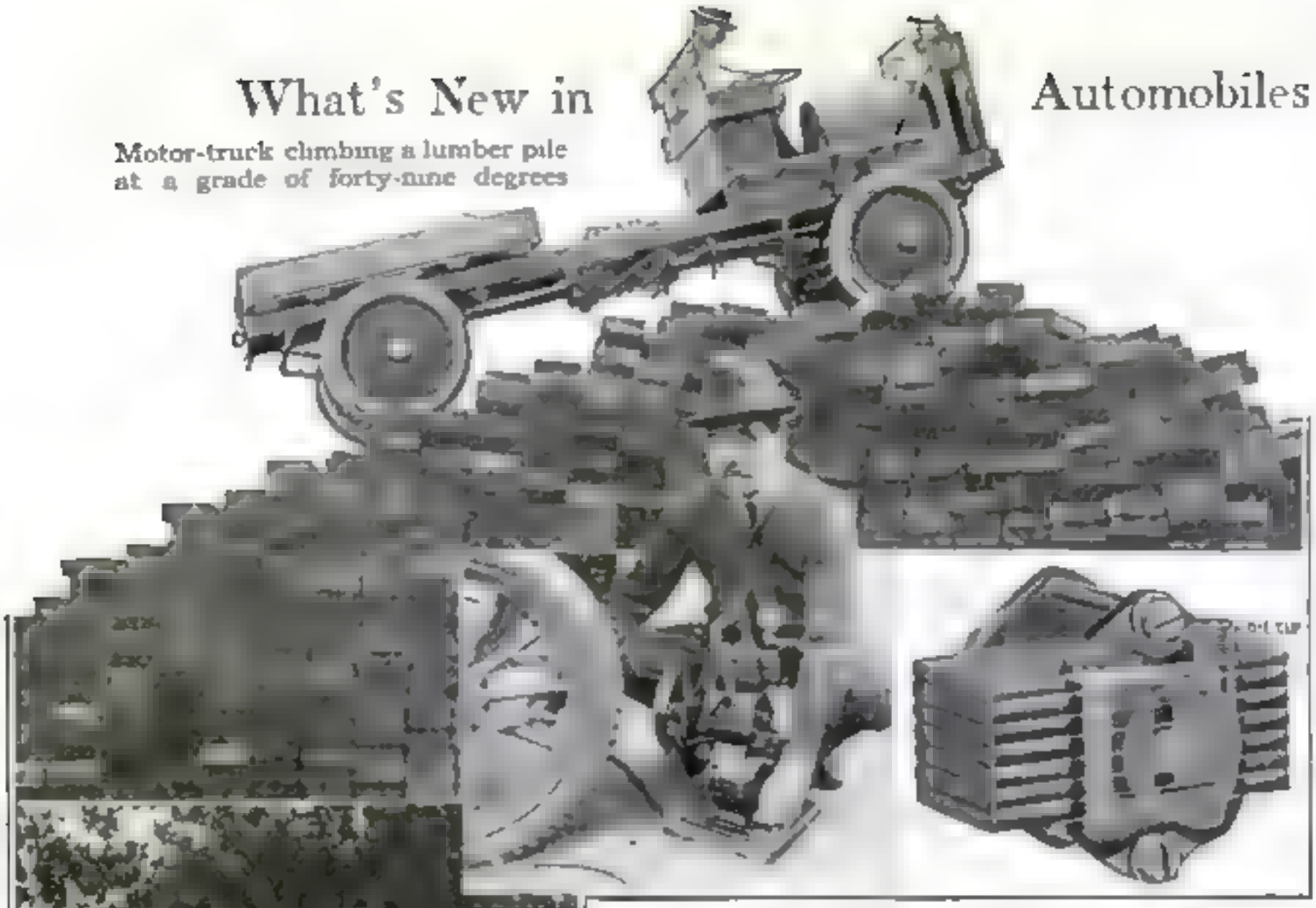
This machine warns the motorist of road dangers ahead



Six trailers heavily loaded with express matter being drawn by an electric tractor at a railway station. The motors are three-wheeled iron boxes containing storage batteries, with a seat for the driver

What's New in Automobiles

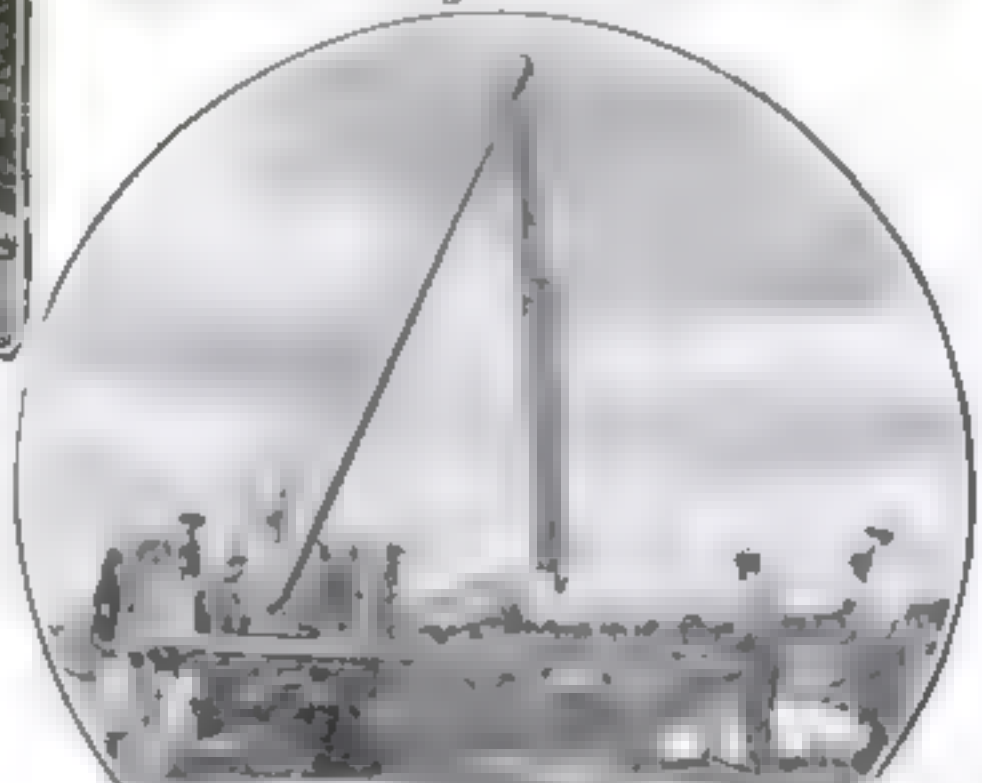
Motor-truck climbing a lumber pile at a grade of forty-nine degrees



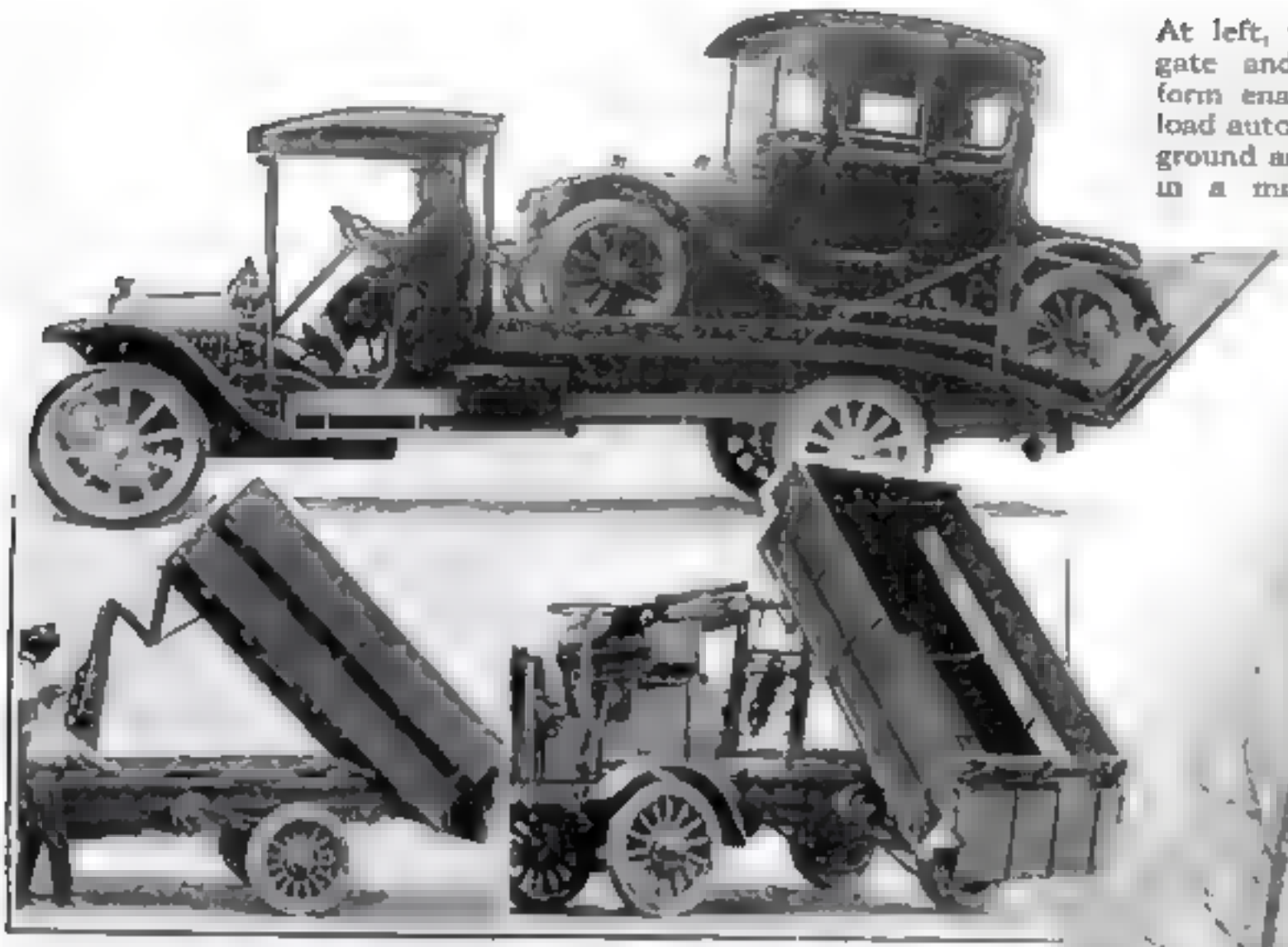
The appetite aroused by motoring can be appeased on a convenient little folding table attached to the door of the automobile

At right, an efficient telephone and fence-pole setting apparatus

At left above, an electric tire-pump of one fourth horsepower. At right, a leaf-spring oiler which diffuses oil through the motion of the car

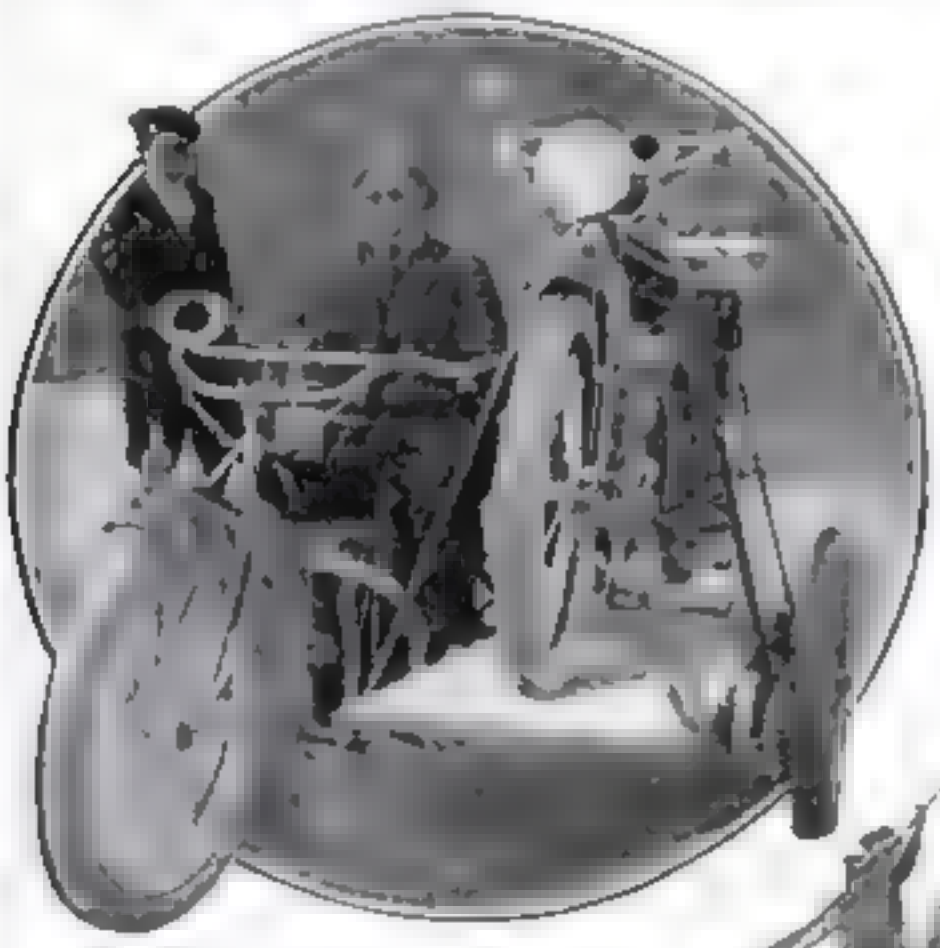


In Tampa, Florida, this convict manned auto-truck is used for street sprinkling in the summer and rubbish gathering in the winter



At left, the hinged tailgate and inclined platform enable this truck to load automobiles from the ground and from box-cars in a minimum of time

The load of the motor-truck shown above can be dumped to either side in the narrowest streets by operating the turntable



Behold a sidecar delivery buckboard Mounted on the chassis are two boards about eight inches wide and six to eight feet long They are strapped together with iron and are equipped with hooks on the four buckboard corners

Roots and all, a five-ton oak tree being loaded on to a motor-truck to be hauled more than fifty miles

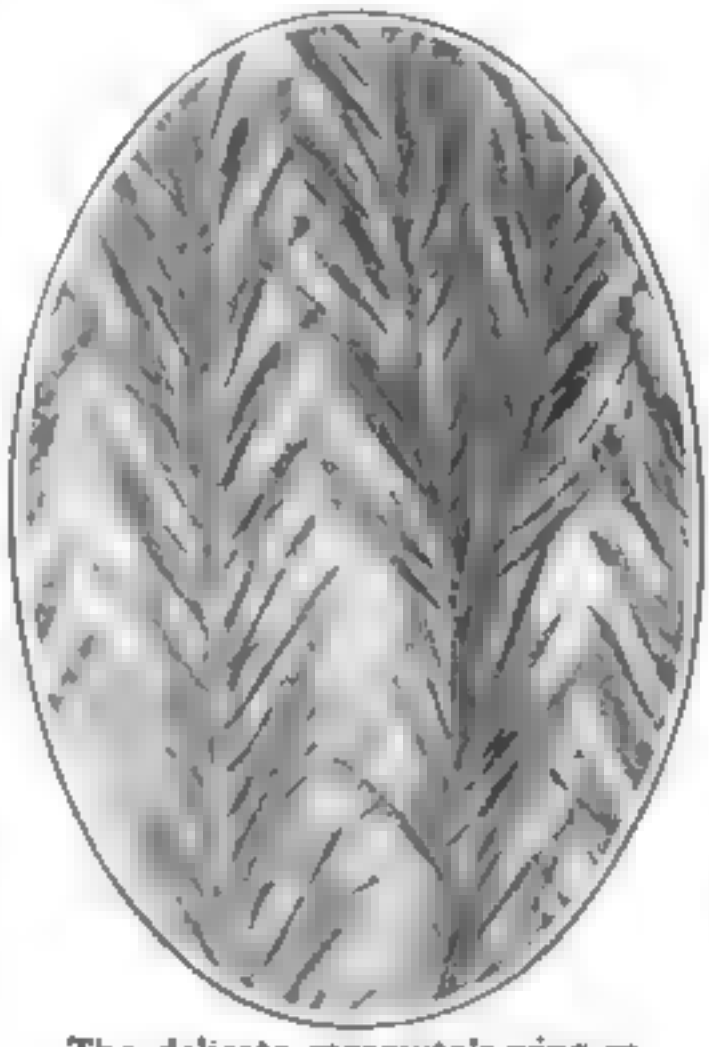
If We Had Eyes Like Microscopes

By Edward F. Bigelow

CERTAIN writers, chiefly Dean Swift and his followers, have taken pains to impress upon their readers the fact that if they had microscopical eyes, all beauty would disappear. The most delicate skin viewed by such eyes would be rough and repulsive; the whole world would be filled with disagreeable sights.

On the other hand many enthusiastic microscopists teach and believe that beauty is increased by the microscope. According to them, if we had microscopical eyes, a world of beauty unimagined would be open to us, and every object would appear to be perfect and beautiful.

The disputed facts are like those in many other cases: each is right from his own point of view. The microscope does detract from the beauty of some things, and reveals new beauty in others. The appearance of nature to a microscopical eye would not be much different from its appearance to what we now consider the normal eye. At present, some things are unpleasant to look at; yet we are living in a world of beauty—everywhere.



The delicate mosquito's wing revealed through microscopical eyes

In some things nature will not bear close scrutiny. In others, she has hidden beauty that is revealed only by the microscope. Among the most beautiful of finely constructed objects, few are perhaps more attractive than a mosquito's wing. Its tiny scales become more and more beautiful and wonderful as we increase our magnifying power.

The utilitarian reader may ask, "Of what use are such things?" They are good to be themselves. It is better to take the world as it is and to study it, than so often to ask, "Why?" It would be difficult to explain the reason for the existence of many of nature's common objects. In regard to the mosquito's wing with its feathers, we can only surmise that these scales may be useful in preventing the air from slipping off too easily; the slight roughness may give the wing a firmer hold on the air. For a similar purpose a bird's wing is feathered, and this reason is brought into more conspicuous prominence by the fact that a fish's fin is free from scales.

Here, aside from its reason for existing, the microscopist finds a realm for delightful investigation; the further afield he goes with his high-power objective, the greater the scope of inquiry. It is impossible in a photomicrograph such as the accompanying, although it is a remarkably good picture, to show the minute details, because the structure is so hyaline or transparent, that it is not easily photographed. Under high powers the wing becomes even more hyaline.

If the reader will think of a room full of smoke, he will understand this. If a small quantity of this smoke-laden atmosphere be taken in a phial, the blueness will become invisible, or at least inconspicuous. When viewing a mosquito's wing it is difficult, under high magnification, to have enough material to make much impression upon the plate; but in a compound microscope the light may be so adjusted that, while the wing may appear almost perfectly transparent, there will yet be sufficient material to make a distinct image in the eye. There seems to be nothing too minute for the microscope to reveal.

Comic Insect Photography

By Lehman Wendell

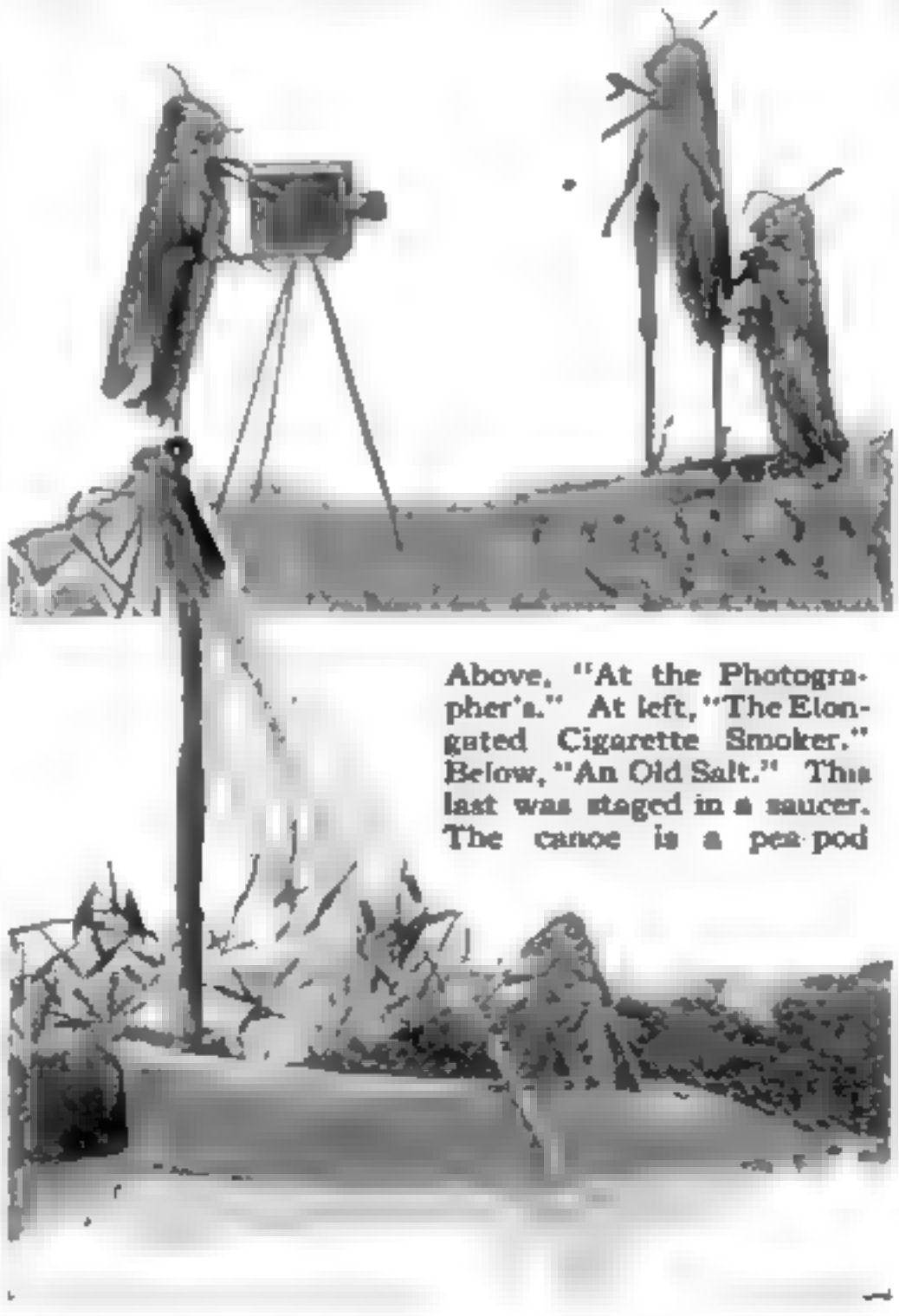
ONE of the most interesting of all photographic diversions is the making of comic insect pictures. Success in this class of work requires a suitable camera, good taste and judgment in composition, and an unlimited amount of patience and perseverance. The importance of the second and third qualifications is too self-evident to need further attention, but a word or two regarding the equipment may not be out of place.

Any plate camera having a long bellows extension and an anastigmat lens will serve the purpose. A so-called miniature camera is preferable to a large one, because by reason of the short focus of the lens it has a greater depth of field and all parts of the picture can be brought into sharp focus at the same time, giving a wealth of microscopic detail throughout the picture. Needless to say, pictures of this class are interesting in proportion to the amount of detail shown.

Plates are preferable to films. They are coated with a finer emulsion, so that enlargements can be made to any reasonable size without presenting a mottled appearance or a loss of detail. Furthermore, plates can be had in such a variety of emulsions and speeds that by proper exposure and development the desired quality of negative can always be obtained.

The pictures accompanying this article were staged and photographed indoors. It would be out of the question to take such pictures out in the open, where the slightest movement of the air would be sufficient to upset the whole scheme of arrangement. The insects themselves were first captured, then anesthetized and posed. The great variety of poses needed for pictures of this kind would, of course, preclude the use of dry museum specimens.

Chloroform is perhaps the best anesthetic for this purpose. The simplest method of administration is as follows: Moisten a pellet of cotton with the chloroform and place it in the bottom of a small wine glass. Next drop the insect into the glass and cover with a small sheet of glass. This will prevent the chloroform from escaping. Complete anesthetization will follow in from two to five minutes. The staging of the picture should be done immediately, and the exposure made before the insect has had time to recover from the effects of the chloroform.



Above, "At the Photographer's." At left, "The Elongated Cigarette Smoker." Below, "An Old Salt." This last was staged in a saucer. The canoe is a pea pod

Naturally, one of the main difficulties is to get the insects to stand upright, but a little ingenuity on the part of the photographer will soon solve each individual

problem. In many cases all that is necessary is to balance the insect carefully against some object, as was done with the cigarette smoker. In other cases a prop of some sort will be required, and this may be thrust into the body and then into the moss. A fine wire is excellent for this purpose. Of course the wire must be carefully hidden.

In most of my pictures the foreground consists of some species of moss. This can be found growing in abundance in rocky localities or in low swampy woods. A great many varieties exist, so that sameness in one's pictures may be avoided. Where bushes are needed to break the monotony of the landscape some kind of lichen may be employed. The kind which I use is found in rocky localities growing in dense masses many feet in circumference. By carefully separating a small portion from the mass, an excellent imitation of underbrush will be obtained.

My backgrounds are, as a rule, white, as this seems to set off the insects to best advantage. A light blue sheet of paper is employed for the purpose, blue photographing white. White paper should not be used as it is apt to reflect too much white light into the camera and produce a fogging of the plate.

Occasionally clouds will be found to add interest to a picture, and these may be printed in from a separate cloud negative made for the purpose. It is well to have a dozen or more such negatives on hand, so that a repetition of the same cloud effect may be avoided.

Now let us consider the production of the pictures one by one. I can perhaps serve the reader best by quoting some of the data recorded in my note book.

"An Old Salt."—Staged in a saucer of water. Background, moss. Canoe, peapod. Paddle carved out of wood. Clouds printed in. Plate, Hammer's Exfast Ortho. Time of exposure, 30 seconds, F:36, near west window, sun bright, 2:30 P. M., August. Pyro tank developer. Cyko enlargement.

"At the Photographer's."—Camera, small cube of wood, dipped in ink. Lens, small section of hay cut at one of the joints. Tripod, three fine wires thrust into the camera, and fine stalks of hay slipped over wires. Other data as before.

A Tool for Buffing, Drilling and Grinding Metal Surfaces

SANDPAPERING and polishing unwieldy or immovable objects is a task, which, done by hand, requires a vast expenditure of time and muscular effort. Portable electric grinders and buffers have been perfected to do the same work in a fraction of the time and with results that exceed the finest of hand work.

A light, compact electric motor on a no-tipping pedestal is provided with a handle by which it is easily carried and with a long cable that is attached to the nearest electric light socket. A snap switch on the side of the motor controls the current supply. Power to turn the buffer or grinder is supplied through a long, flexible tube.

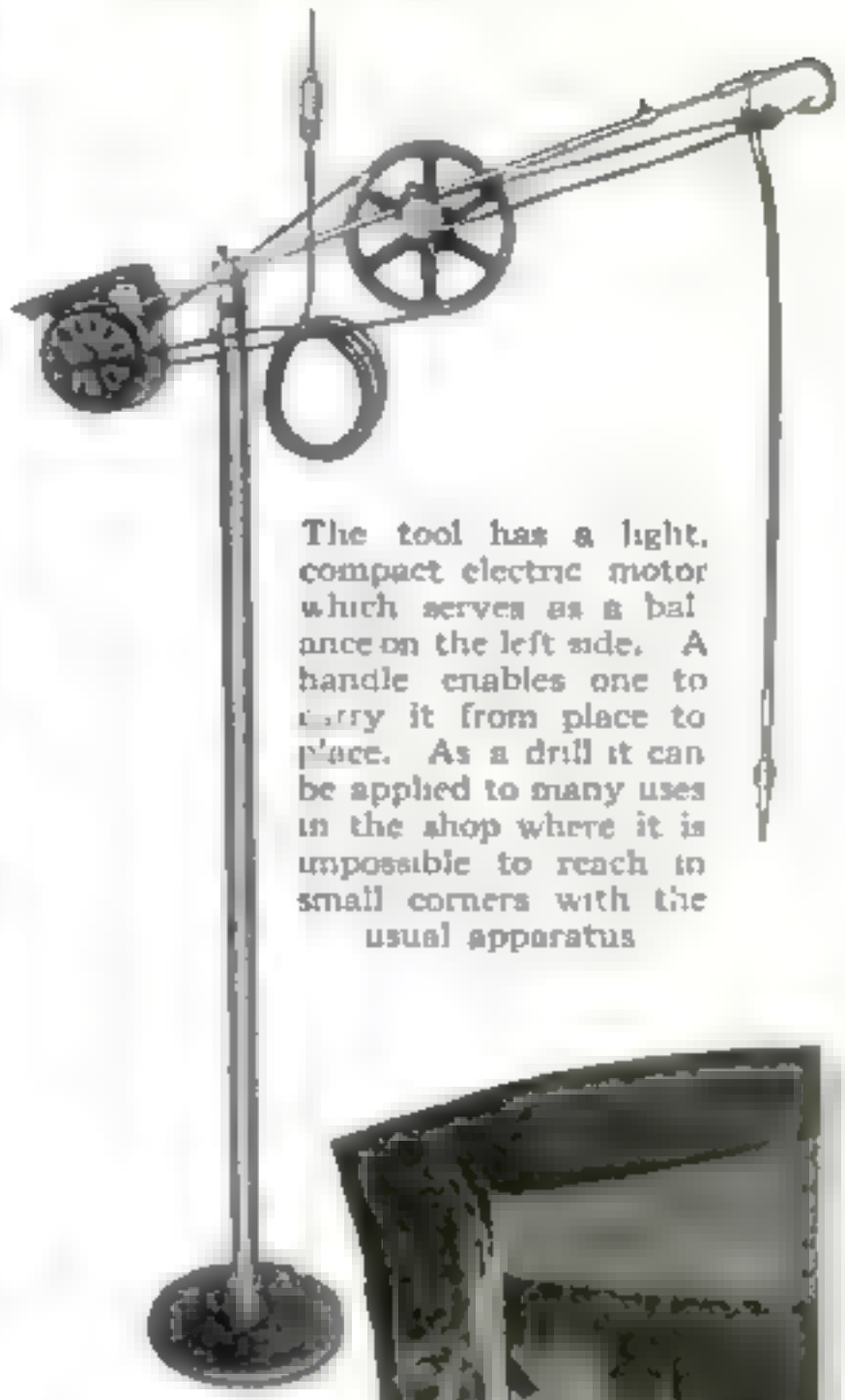
The instrument has found its way into a variety of interesting uses. Some adaptations of it are employed in automobile garages for polishing brass and enameled surfaces. Crevices which could only be reached with difficulty are cleaned out in an instant by the whirring disk. This tool finds itself welcome in workshops where odd and difficult jobs such as die-sinking, drilling, buffing, grinding and those of similar nature are daily encountered. Another form of the tool helps in lightening the task of the floor-layer. In this case, the motor is attached to the ceiling and the flexible tube operated from the end of a long pivoted arm. Among the other unique applications of the buffer and grinder are those of cleansing household utensils, signs on the front of buildings and performing other tasks of an equally diversified nature.

Pneumatic Gun with a Dynamite Shell

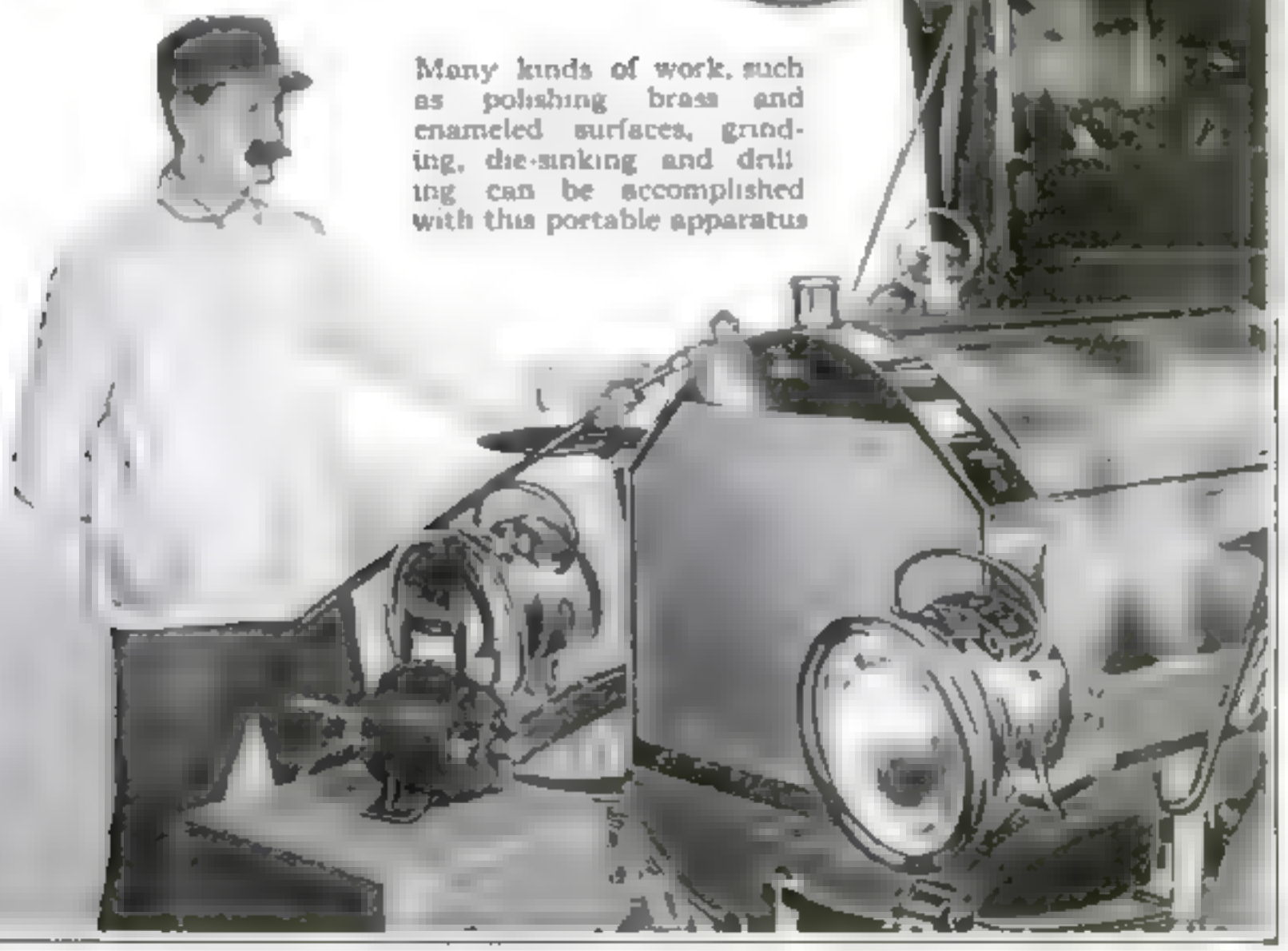
A BALTIMORE man has laid before the navy officials the plans for a pneumatic gun with a dynamite shell. It is said that a test of the gun is shortly to be made. The inventor began working on his invention some months before the war started, and only completed it last summer. The latest model is a 20-pounder, which he has made adjustable to hurl a dynamite bomb as far as 22 miles.

What a Little Electric Motor Can Do

Buffing a copper caldron



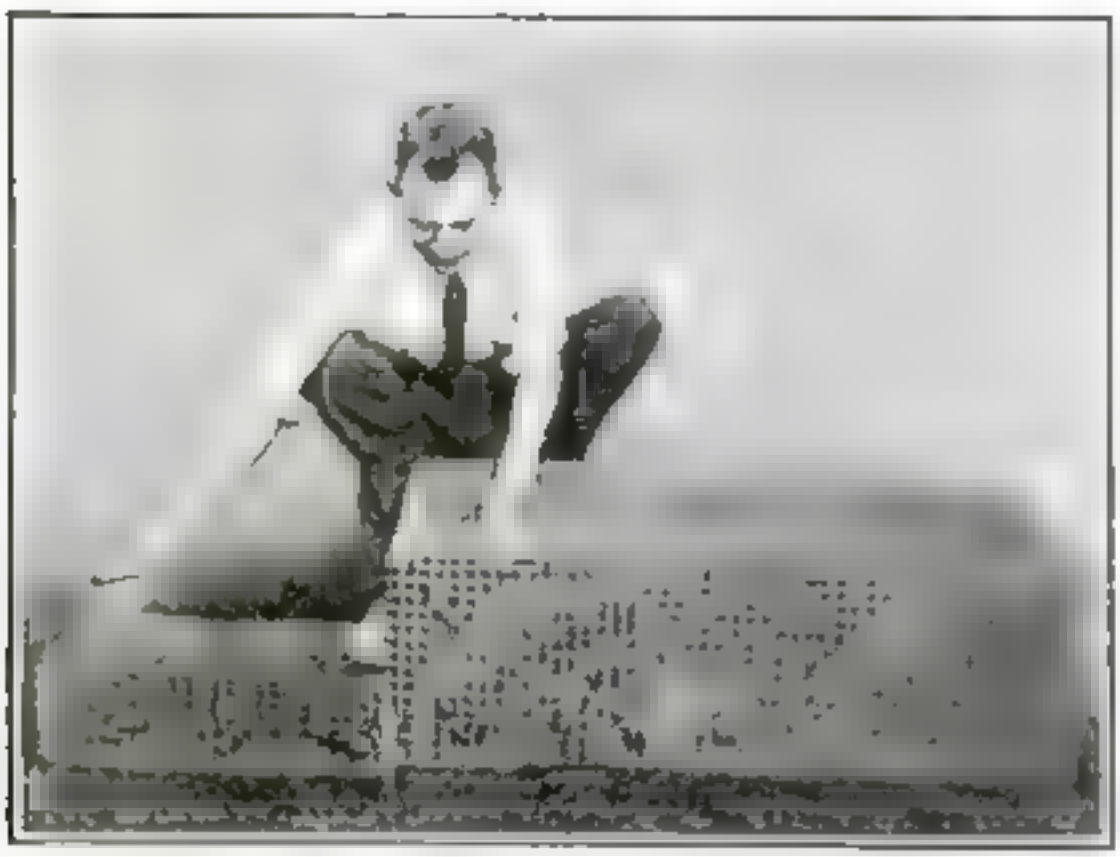
The tool has a light, compact electric motor which serves as a balance on the left side. A handle enables one to carry it from place to place. As a drill it can be applied to many uses in the shop where it is impossible to reach in small corners with the usual apparatus



Many kinds of work, such as polishing brass and enameled surfaces, grinding, die-sinking and drilling can be accomplished with this portable apparatus

It is an advantage to bring the tool to its work. All that is needed is an ordinary electric light socket. As a polisher for the various automobile brass parts the tool is especially useful

Trapping English Sparrows for Food



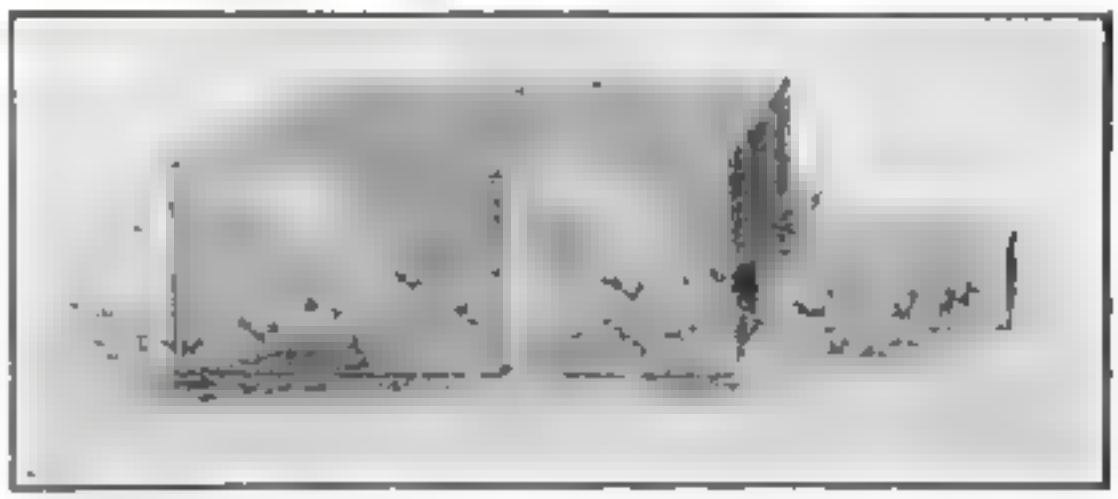
The mouths of the funnel are just large enough to admit the sparrow and keep him prisoner

HEREWITH is shown a trap for catching the English sparrow which is one hundred per cent efficient, if properly operated. It is made of tinned wire, electrically welded, strong and durable. The size of the trap is thirty-six by eighteen by twelve inches, and weighs twenty-five pounds.

The United States Department of Agriculture advocates the destruction of the English sparrows, calling them "noisy, quarrelsome, filthy and destructive." Native song-birds will never come back to our gardens in increasing numbers until the English sparrow is banished. These pugnacious birds are extremely cunning, and it is hard to trap them. But there is no trouble in enticing them into the trap shown if the proper kind of bait is used for a particular locality.

The flexible needle-points at the mouths of the funnels can be adjusted so as to be just large enough to admit the sparrow and yet not large enough for him to return. One family who used cracked corn for bait caught seven hundred and twenty-nine sparrows in sixty days. The usual method is to sprinkle bread crumbs for six feet around the trap, leading the crumbs into the funnel. Large pieces of stale bread are used near and in the trap. Sparrows, being like hogs, in that they like to get where the big feed is, soon go from the first into the second division, from which they are easily forced into the last part, from which they are taken.

There is no reason why sparrows should not be utilized for food, as they have been in the Old World for centuries. Their flesh is palatable, and though their bodies are small, their number fully compensates for their lack of size. Birds that have been trapped have been kept in large out-door cages, sheltered from storms and cold winds, until they are wanted for the table. It is unprofitable to keep them long, as the quantity of grain or other food they require daily amounts to more than half their own weight. A variety of food is necessary to keep them in good condition. Bread, oats, wheat, bran and corn-meal mush, lettuce, cabbage and tender shoots of sprouting grain are some of the things they relish. Some time ago ex-Governor Cox of Ohio gave a banquet to some of his friends, when the piece de resistance for the occasion was a sparrow-pie. Until after the banquet the guests were under the impression they were eating a pie made of squabs or reed-birds.



The bird-trap can be used at any place where sparrows congregate, even on the roofs of city apartment houses

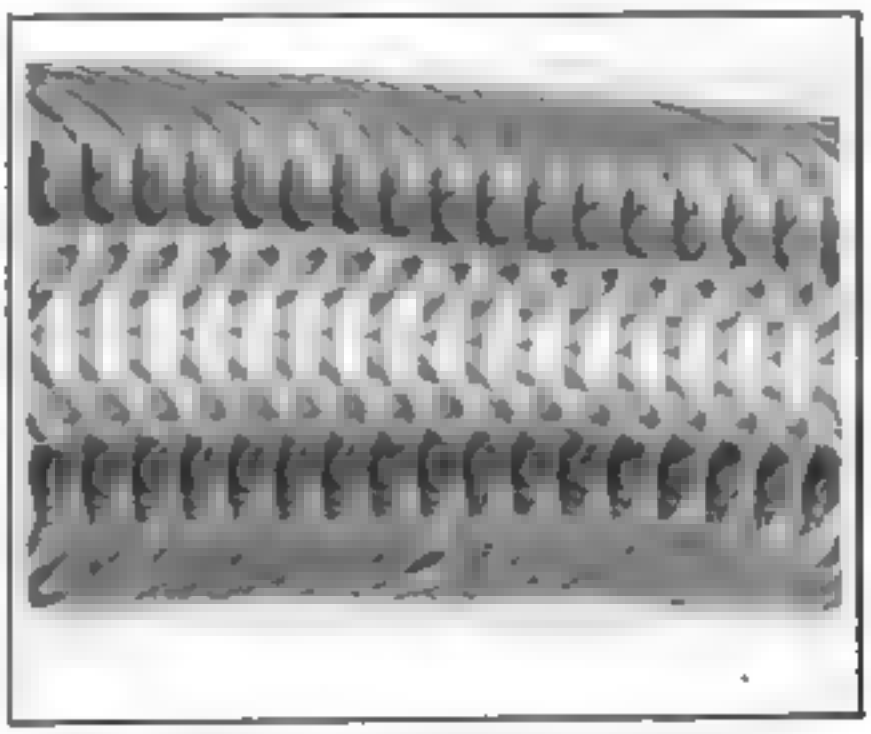
A New Garden Duster Which Uses Dry Spray

THE use of dry sprays instead of liquid poisons is coming into favor among garden makers because they involve less work, are not so dirty and are ready for instant use. A new hand duster for applying dry sprays is novel in principle as well as design and is by far the most efficient device which has yet been invented. The powder is contained in a large metal reservoir, within which the pump mechanism acts. Each movement of the piston automatically measures and ejects an amount of dust regulated by the force imparted to the piston. It is double acting and will throw a cloud of dust or powder up or down or in any other direction. With this new duster a single puff of arsenate of lead will completely cover a potato plant with the poison. All vegetables and small fruits and even low trees may be quickly sprayed with poison or with sulphur with a minimum of effort.

The duster may also be used as a house disinfectant, discarding the arsenate of lead for a non-poisonous liquid or powder. No corner is beyond reach of the duster, and the acids used as sprays do not injure it.

The liquid is forced into the recesses of vegetables, small fruits and low trees

How the Snail's Tongue Cleans the Aquarium



The snail has a tongue which closely resembles the teeth on a carpenter's rasp

EVERY one who keeps an aquarium knows that it is advisable to place a few snails in the tank, not only because snails are interesting in themselves, but because they are good cleaners. If the keeper of the aquarium knows that too much sunlight will produce too much plant growth, and has placed the vessel in a partly shaded place where the proportion of light and shade is about right, the snails, if they are numerous enough, can then control the growth. They creep along the side of the aquarium, as if they were idling away their time and merely crawling around to call on their neighbors. In reality they are not dreamers but scavengers.

Nature has provided them with a peculiar anatomical structure resembling a narrow ribbon, which in detail is like the band of teeth on a carpenter's rasp. Under the microscope these so-called "lingual ribbons" or tongues are seen to be thickly set with rows of sharp-edged teeth which are themselves toothed and which rasp off microscopic plants and carry them into the mouth.

The accompanying illustration is from a marine form known as the "bleeding-teeth" snail. In the original the ribbon has a bright reddish color as if it had been dipped in blood. When the image is thrown on the screen by the projection microscope, it resembles a huge red rasp three or four feet in diameter and extending across the entire width of the screen.

Machines That Smoke Cigars

The Modern Way of Sampling Tobacco Leaf

Above, the aspirator and siphon apparatus for testing tobacco leaf. It smokes four cigars in thirty minutes. At left, the blower outfit which is operated by electricity. The smoke is coming from the exhaust outlet

THERE are tea-tasters, perfume-smellers and silk-feelers, but when it comes to smoking cigars to determine their uniform burning, their ash color, and the aroma of the smoke the human element is entirely dispensed with and machines—cigar-smoking machines that can smoke four cigars at once and never smoke themselves to death—are used. These are of two kinds. The cigar buyers use a simple blower outfit, and the Bureau of Plant Industry of the Department of Agriculture tests its tobacco leaf with an aspirator and siphon apparatus.

When the buyers come to New York for their season's supply of tobacco they take the blower machine with them, and after selecting certain qualities of tobacco have cigars made up on the spot, connect the blower to an ordinary lamp socket, insert the cigars and watch results. The way the cigar burns, the color of its ash and the aroma of the smoke are indications as to the quality and desirability of that certain brand.

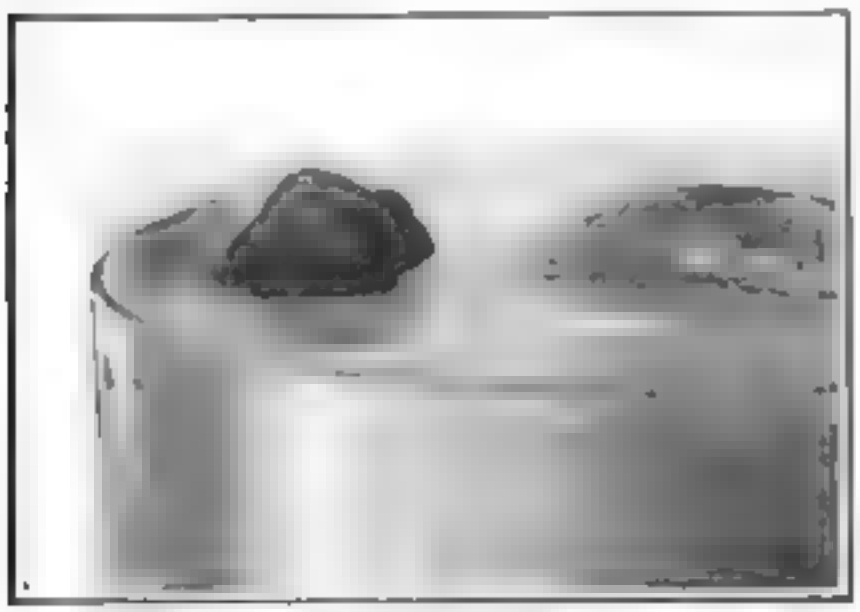
The Bureau of Plant Industry has an interest in tobacco entirely different from the cigar buyer. It is endeavoring to improve tobacco by a scientific study of the different brands. To eliminate the personal equation in smoking and to secure uniformity of conditions the Bureau has a unique apparatus for testing the burning quality of cigars. The "pull" on the cigar is secured by means of an aspirator which is filled by a continuous inflow of water and emptied at regular intervals by a siphon. The "pull" occurs at intervals of thirty seconds and continues for a period of ten seconds. The apparatus smokes four cigars of the perfecto type in about thirty minutes.

There are several elements which go to make up a good or bad burn, chief of which are the capacity for holding fire, the evenness of the burn, the color of the ash and its firmness, the coaling or carbonization, and the "puckering" of the leaf immediately in advance of the burning zone of the cigar. The final test of any cigar tobacco must, of course, rest in the smoking of the manufactured cigar, but, while this gives a direct means of determining the character of the ash, it does not furnish accurate information as to the evenness of the burn or the fire-holding capacity of any one of the components used in the experiment. Tests have been made using different fillers and binders with the same wrappers.

Rocks Composed of Diatom Earth Which Float

A NUMBER of rocks are so light that they float on water. Most of them consist of diatom earth, which is a soft earthy material like chalk, but differs from it in being composed chiefly of silica-containing plants mixed with the remains of submerged organic growths, or diatoms. Diatoms flourish in the surface water of parts of the ocean, especially in the South Atlantic, where they are so abundant as to becloud it and where they serve as food for whales. Their remains sink to the bottom and form great accumulations of diatom ooze.

Diatom earth is found in many parts of the world, and is extensively used for polishing. It has been used also as an absorbent in the manufacture of explosives, and as a packing about steam boilers. The "silver white" of commerce is diatom earth. In the United States it occurs at many localities, of which two



On the left is a piece of rhyolitic pumice and on the right a piece of hydrocarbon

may be mentioned. Near Richmond, Virginia, it forms a bed thirty feet thick and one hundred miles in extent; and near Monterey, California, there is a bed of it fifty feet in thickness, but of unknown extent.

When samples of it are subjected to a water bath for hours they seem not to absorb the water. To attempt to "waterlog" a piece of pumice is foolhardy.

The Colorado River after one of its overflows when the water has receded and the western sunlight has baked the bed

A Mud Mosaic in the Wake of the Treacherous Colorado

WHEN the great Colorado River goes on a rampage and overflows its banks it deposits vast quantities of mud and sediment. In this way it has built up the enormous rich Colorado delta in Arizona and Southern California, cutting out, through the countless ages, the huge gorge of the Grand Canyon, in many places a mile deep through the rock. The photograph shows what happens to the Colorado River clay, upon the recession of the waters. Drying under the intensely hot sun, which normally reaches one hundred and fifteen to one hundred and twenty degrees in the shade, and cracking into innumerable irregular blocks, it forms a vast natural mosaic. In some places where the water has stood over a flat, this mosaic extends as far as the eye can distinguish.

The Colorado delta is intensely arid in character, only a few clumps of salt bushes being able to subsist. Where it has been irrigated the yields are enormous. The fertility of the soil is almost inexhaustible. The complete harnessing of the Colorado and the utilization of its tremendous flood-flow constitute one of the really big reclamation engineering problems of the day.

Fighting the Sand-Peril

At left, the sand encroaching upon valuable fruit-growing land, stifling it to death. It travels with an utter disregard of all barriers thrown against it by man

Below, boards erected to shift the sand and prevent the railroad tracks from being covered. These barriers do not last long under such ruthless and persistent wear

TO make a successful fight against the ever-moving sand dunes of the Columbia River region and at other places along the Pacific Coast, the United States must follow the plan adopted by France many years ago. It must build one great dune in an effort to eliminate many smaller ones. This is the verdict of Forest Service experts who have made a world-wide study of sand dunes and methods employed to combat them. Since the planting of forests has been found to be the most effective means of checking the encroachments of sand the problem is one that comes within the jurisdiction of the United States Forest Service.

In the lower Columbia River valley, both in Washington and Oregon, sand dunes are destroying farms and orchards and are changing country of great fertility into waste land. Bearing orchards have been completely engulfed by dunes and buildings have been buried to the roof line. Railroads have suffered heavily and have spent large sums in efforts to keep their tracks from being buried.

A hundred years ago France was confronted with a problem equally as serious. More than 300 miles of coast-line on the Bay of Biscay was being blown inland by the winds of the Atlantic Ocean. The most fertile portion of the country was threatened. Eventually some one hit upon a plan of building a great lateral dune along the entire coast as a means of checking the movement of the sand. About seventy years ago France set to work on this great task. She only started the building of the dune, however, when Nature took up the work and completed it.

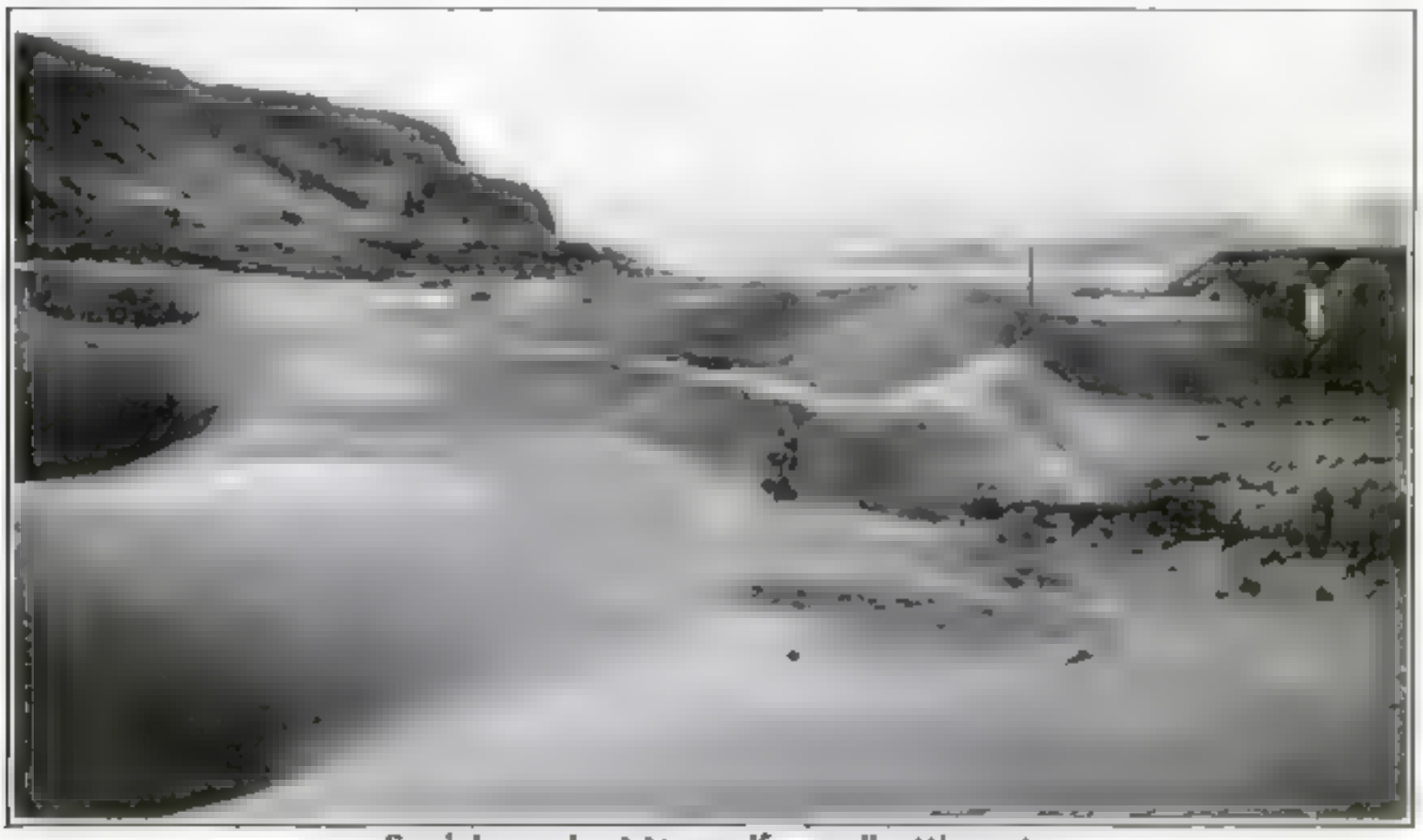
The entire coast-line was fringed by a fence consisting of posts driven in the ground at close intervals, and the spaces between them were interwoven with willow branches and brush. Soon the strong winds blowing in from the ocean banked a great wall against this fence and eventually it was entirely covered with sand. Then a second line of fence was erected on the small lateral dune thus created. In time this fence was covered by the sand which banked up against it. This operation was repeated many times and then other means of increasing the size of the dune were used. Native grasses that thrive in sandy soil were planted along the top of the dune; this served to keep its height as uniform as possible by preventing the winds from carving indentations in the face of the pile. Pine trees were planted along the top. These served to check the wind-blown sand as the fences had done in past years, and day by day the dune grew in height and widened out. As it increased in size more pine trees were planted.

To-day a great forest 2,500,000 acres in extent fringes the coast-line as the result of this initial experiment. It represents France's greatest supply house of turpentine and lumber. The country lying inland from it is rich and fertile. The sand menace has disappeared, and it cannot return.

The situation on the Pacific Coast is similar in one respect to that which confronted France. The sand is blown inland by the high winds from the ocean. The situation on the Atlantic Coast is just the opposite, however. There the sand is blown seaward, by winds coming from the land.

In the Columbia River region the sand is much lighter in weight than the sand of the Atlantic Coast, due to the large quantity of mica which it contains. This makes it easily carried by the wind. It also gives it great fertility when once watered, so that with the reclamation of the sand dunes there are possibilities of cultivating profitable orchards and farm lands in connection with the belts of forest which will necessarily have to be established.

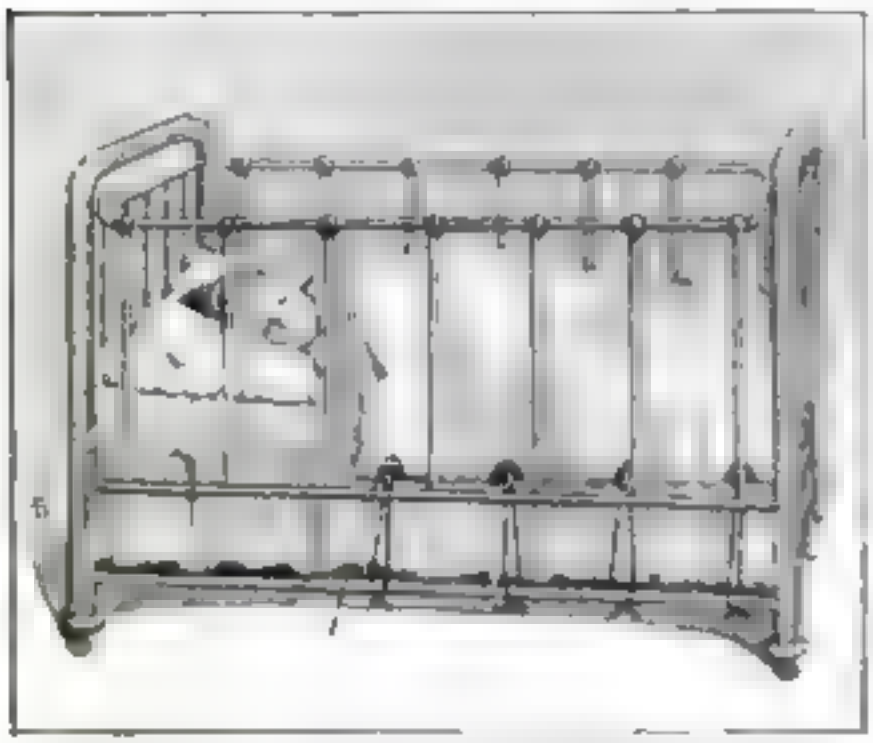
Many dunes in the lower Columbia River valley are more than thirty feet high, and several even more. The accompanying photographs illustrate some of the problems caused by the dunes. Railroads have spent thousands of dollars in rough fences, known as hurdles, in an effort to keep their tracks from being submerged. Irrigation ditches have been moved from time to time to prevent them from being filled with sand.



Sand dunes about to engulf a small settlement

Device to Hold Covers on Sleeping Child in Crib

SEW a one-eighth-inch wire to outside cover of bed—a spread or quilt or sheet. Sew a piece on each long side and on the short side at the foot of the



The most restless baby cannot pull this coverlet off because it is securely fastened on both sides

crib. Tie the wire with tape to the rod on the bedstead that parallels the wire. Small rings can be put on the wire about twelve inches apart if desired. To open covers, untie the tape.

The other covers are held in position simply by pinning them all to the top one in two places.

The Motor-Cycle Street-Sweeper

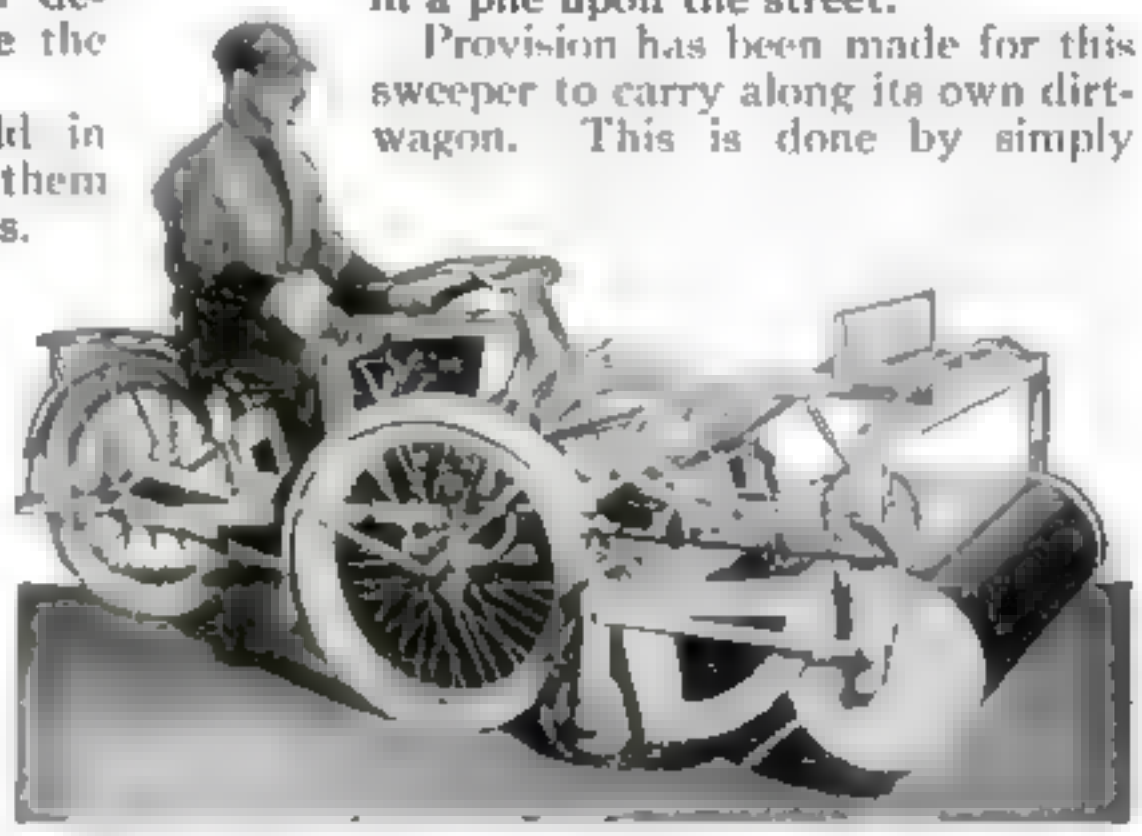
AN innovation in street-sweepers has just appeared in Los Angeles, California. It is the combined invention of T. C. Girton, F. C. Hoffer and J. F. Smedley of that city and is a combination of an ordinary twin-cylinder motor-cycle and a sweeping apparatus. The engine in the motor-cycle furnishes the motive power by which the entire outfit is driven.

It is a one-man machine, while the gasoline, oil and brush, which are its only other continual expenses, are hardly large enough to be worth mentioning. It may be operated from two to twenty miles an hour, while at the eight-mile speed it works best. It will do the work of about twenty men.

The front end is taken up by the sweeper mechanism, located in front of a pair of wheels, which, in turn are, practically speaking, in front of the motor-cycle proper. Both wheels and sweeper mechanism are fastened to the motor-cycle by means of an angle-iron frame, the operation of the wheels being controlled by the handlebars. The brush, which is about sixty inches in length, is immediately in front of the pair of wheels and is operated by a lever at the side of the driver, who, by pushing one of the levers forward raises or lowers the brush at will. The cylindrical sheet-iron drum, with an apron attached, is suspended just in front of the brush. Over this apron the dirt is swept into the drum, the brush being chain-propelled by the engine of the motor-cycle.

By pressing forward another lever the driver is able at a moment's notice and without dismounting to turn the drum, which has a capacity of about four bushels, so that its contents will fall in a pile upon the street.

Provision has been made for this sweeper to carry along its own dirt-wagon. This is done by simply



This machine sweeps a street without creating so much dust as a hand sweeper

fastening that part of the outfit to the rear of the motor-cycle. If at any time the sweeper mechanism should give any trouble, the simple pushing forward of a lever at the driver's side lifts a metal tray which covers the brush and receiving side of the drum, placing it immediately open for examination.

A Luminous Life-Belt for Rescue at Night

TWO electric flash lamps wrapped in a casing impervious to water can be attached to any one of the several types of life-preservers and be made to light a person in the water at night and thus facilitate rescue. Furthermore, the lamps may be so constructed that in case it is desirable to throw overboard any type of buoyant life-preserver, the lights may be switched on immediately before casting on the water, so that a person in danger of drowning can see his way.

The preserver may be fitted with one or more lamps, as desired. Surrounding the holder is an impervious sack or pocket, preferably of rubber, and provided with an elastic beaded mouth adapted to be tightly fitted around the lamp-holder below the lens in such manner that water will not enter. On the sides of the pocket are formed loops acting as securing means for straps provided with buckles and tongues. Once the straps are firmly clasped around the preserver the lamps are held rigid. An open space is allowed so that the lamp switch may be operated.

The life-belt consists of a preserver with one or more lamps rigidly fastened in position

Where landings are particularly dangerous at night motor-boat parties have used the luminous life-belt to illuminate the water and determine the safest place to dock. The belt is thrown overboard when the boat approaches a landing place and serves admirably as a buoy light.

Seeing Yourself as the Oil Well Sees You

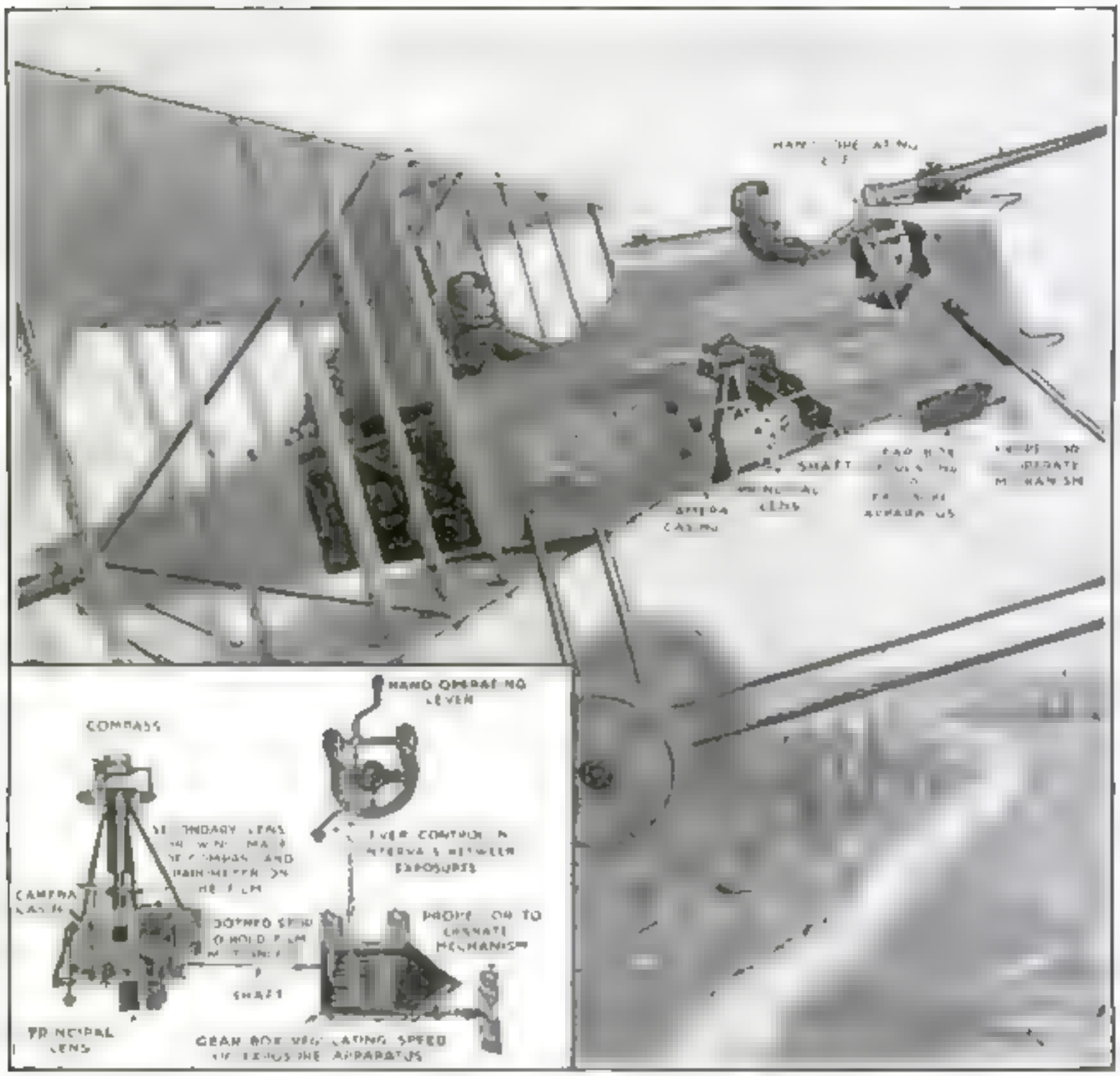
THIS photograph of an oil derrick is about as unsolvable a puzzle picture as is often seen. Were it not for the

We leave this to you. Is this photograph upside down or not?

grass and shadow of the lake bank in the foreground it would be impossible to tell which was the top and which the bottom of the picture. Or, if the picture of the smaller or more distant derrick to the right is considered alone, no one can tell the reality from the reflection. The reason for this absolute perfection in reflection is that the lake is of oil.

In the great southern California oil fields, where gushers are being struck which flow from ten thousand to sixty thousand barrels of oil a day, and flow continually every minute of the day and every minute of the night, the only possible way to save the oil is to quickly throw up an emergency earthen dam across some convenient ravine and turn the oil flow into the reservoir formed.

A Photographic Eye for the Airman



With this camera apparatus every detail of the world below the airman is minutely registered on the roll of film which runs over the camera lens at a speed regulated by the operator

GREATER progress has been made in aerial photography during the present war than in the years following 1858, when M. Nadar, of Paris, took a view of that city by means of a camera attached to the basket of a balloon. The fact that a photograph from an aeroplane of fortifications, damaged railways, bodies of troops, and the contour of the enemy's country gives valuable information which is absolutely reliable, not being dependent for its accuracy on the skill and coolness of the observer, makes this form of reconnaissance of the highest military importance.

Indeed, it is of such value that a dozen different types of aerial photographing apparatus have been evolved in the short duration of the present world struggle. The latest development is found in the Fabbri automatic aeroplane camera, which includes some features already tried out by other inventors but which is, in the main, an ingenious mechanism of original construction. With it an aerial scout can take a continuous photograph of the earth's surface one hundred and thirty miles long. When operated on an aeroplane at an altitude of two thousand feet it will take into its field a strip of ground one thousand two hundred feet wide. In clear weather excellent work

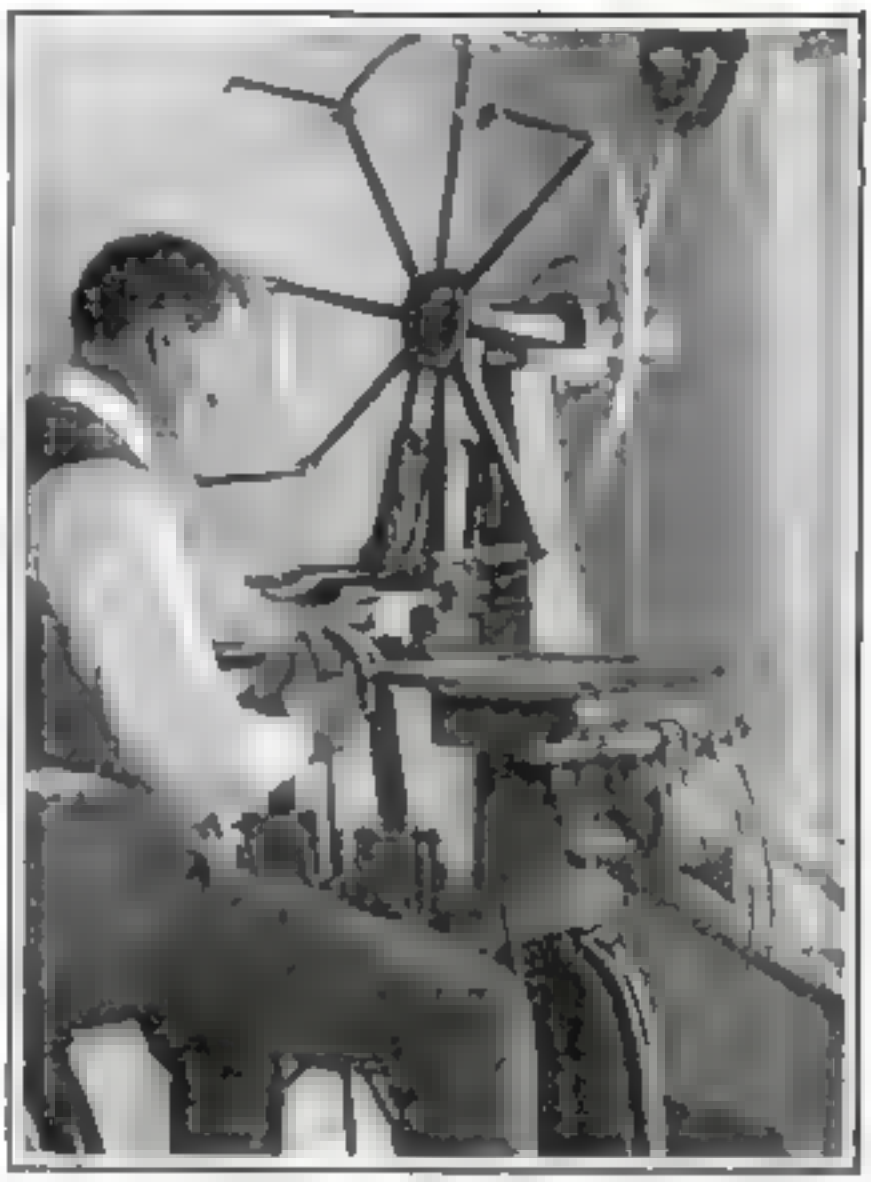
can be done at four thousand feet, in which case the width of the field is about two thousand, four hundred feet.

Suppose a scout is given orders to photograph the entire territory occupied by the enemy. He regulates his camera, soars aloft, and when over the enemy's trenches at an altitude of two thousand feet, for instance, turns a lever which releases a propeller in front of a gear box, which, in turn, starts the camera mechanism in motion. Instantly he obtains a continuous photograph of the earth's surface one thousand, two hundred feet wide.

Should he desire to get more useful information by continuing his flight at a higher altitude, he stops the camera mechanism and ascends to twice the height. There he makes a readjustment of the apparatus and continues his flight, taking a continuous photograph meantime. Mile after mile he continues, until, if he so wishes, he can obtain a photographic record of one hundred and thirty miles of the enemy's territory.

Briefly, the camera consists of a camera box containing two rollers round which the film is carried. The film has a series of perforations along one edge, and a toothed stop is provided to engage with these and hold the film motionless when required. The box is impervious to light, and has a lens pointing downward, through which the main photograph is taken. It has also another lens pointing directly upward, which produces photographs at desired intervals of the exact position of the compass and aneroid needles situated in the holding case above. This last-named photograph automatically registers on the film the direction and altitude of the aeroplane when the exposure was made.

The film rollers are driven by a propeller through the gear box. The hand lever controls the intervals of exposure by varying the speed of the shaft as compared with that of the propeller. The shaft may be operated by hand through the lever and a single photograph be taken, the propeller being for the moment put out of gear.

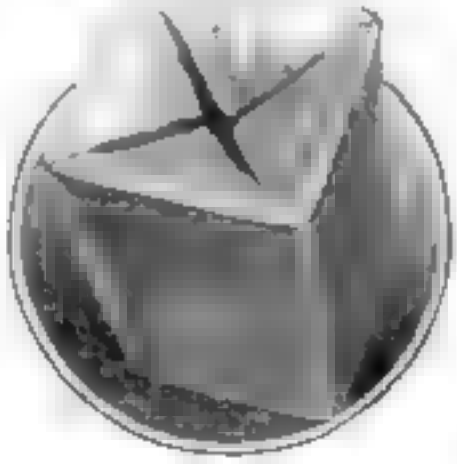


The ingenious baseball sewing-machine which pulls the covers together and stitches them

A Machine That Stitches Baseball Covers

A SEWING-MACHINE has been invented for stitching together the covers of a baseball. It has a mechanism for holding the ball in position while it is being stitched and pulls the covers together over the ball while the stitch is being taken.

The clamping jaws hold the ball while a wheel above is turned to bring its needle gripping fingers into position to outwardly grip and release the needle which sews the covers. A cam device regulates the needle action.

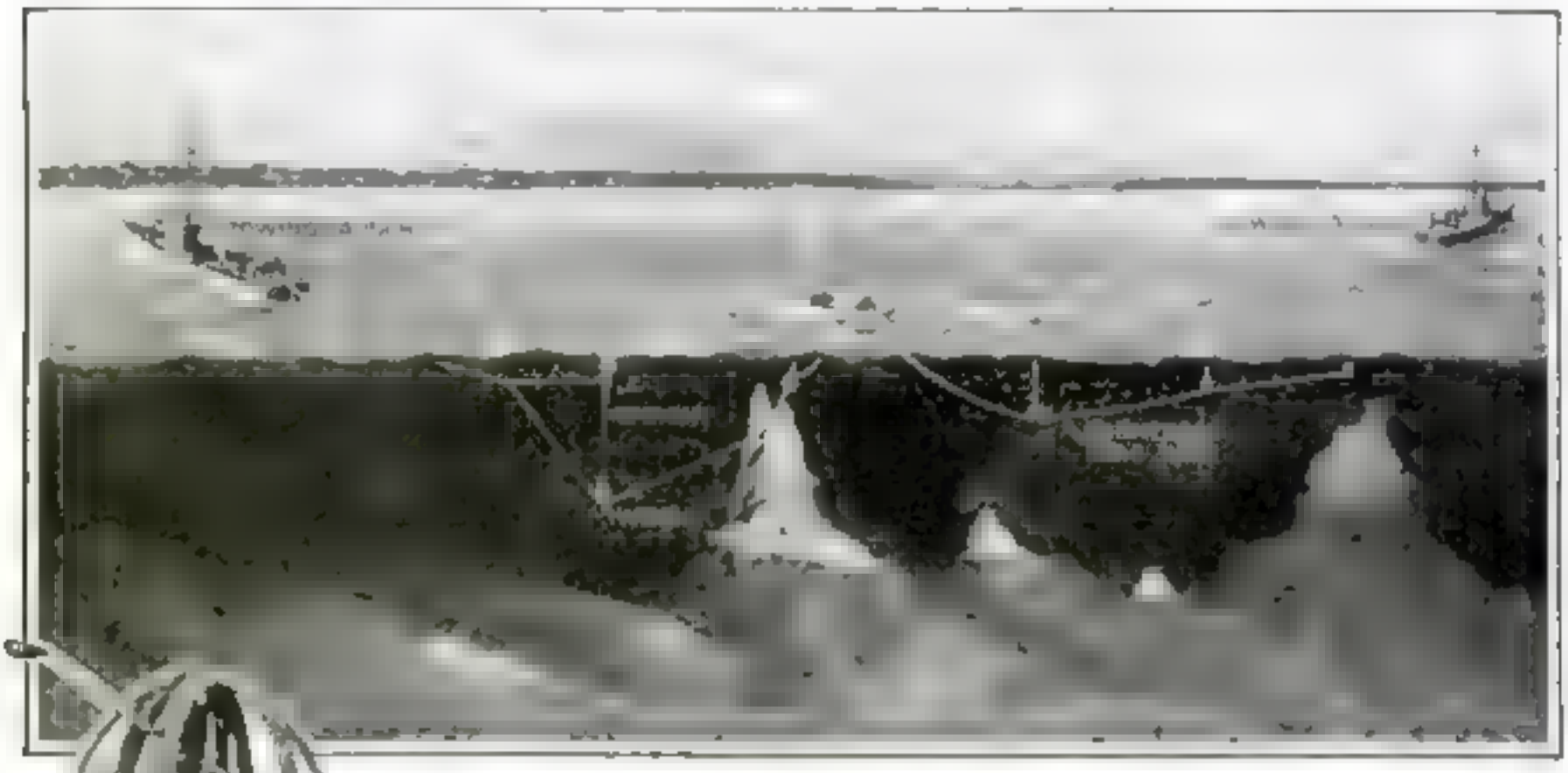


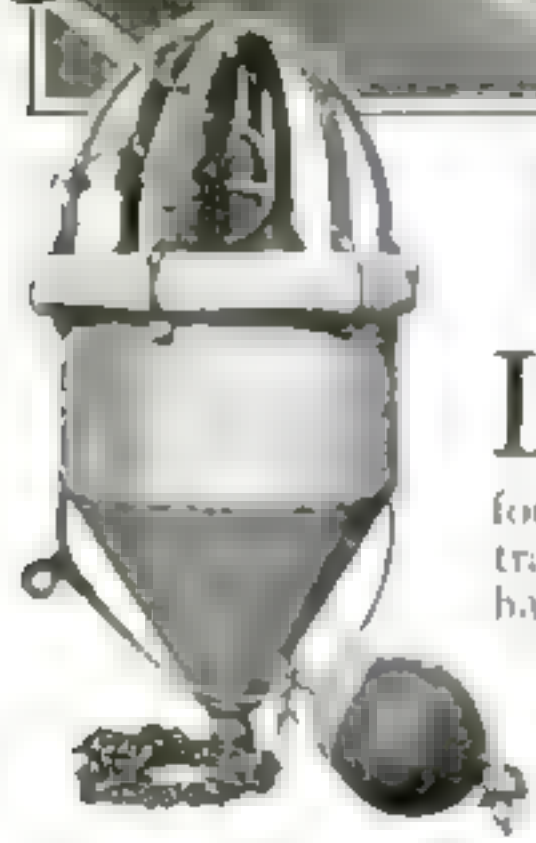
This can will trap every inquisitive animal that sticks its head into it

Trapping Animals by "Canning" Them

A FIVE-gallon gasoline can cut at the top from corner to corner and with the sharp edges bent inward, constitutes a trap for animals that never fails to work. When the animal enters the can with its head the sharp edges prevent it from extracting it and escaping.

Charting the Dangers of the Deep





Disentangling and measuring the depth of the submerged wire drag after it has struck an uncharted rock. With the lead line the discovery of this rock would have been more or less a chance. At left, the buoy or float with the upright and weight attached

LAST summer a submerged rock was found at the entrance to Boston harbor, close to which one or more of our [illegible] million-dollar super-dreadnoughts had repeatedly passed under the supposition that the water was forty-five feet deep, whereas it was actually only twenty-three feet deep. Before that a rocky pinnacle was discovered in Alaska waters, higher than the Washington monument, lying directly in the steamship lane. Only seventeen feet of water covered it. These are striking examples of the valuable service rendered the world's shipping interests by the United States Coast and Geodetic Survey.

No one branch of the Government plays a more important part in the welfare of the country than the Coast Survey. It is not only the oldest scientific bureau in the Government, but the oldest bureau of continuous service. Although its chief work is defined as the making of navigational charts of the United States and outlying territory, the Coast Survey gives the man who follows the sea a complete knowledge of the coast, its nature and form, the character of the adjacent sea-bottom, the positions of reefs, shoals and other dangers to navigation, the rise and fall of the tides, the direction and strength of the currents and the character and amount of magnetic disturbance.

The chief operation in a hydrographic survey is sounding. A hand line or a sounding machine is used, depending on the depth of the waters, but the comparatively recent wire-drag, introduced by French hydrographers and since developed and improved by the Coast Survey, has revolutionized hydrographic surveying. The wire-drag was first used on the Atlantic Coast in 1906, and from that time to the present one thousand, six hundred and sixty square miles have been dragged and about five thousand shoals examined. On the Pacific Coast this work was undertaken in 1914. Probably one-half of the shoals examined had less depth than charted.

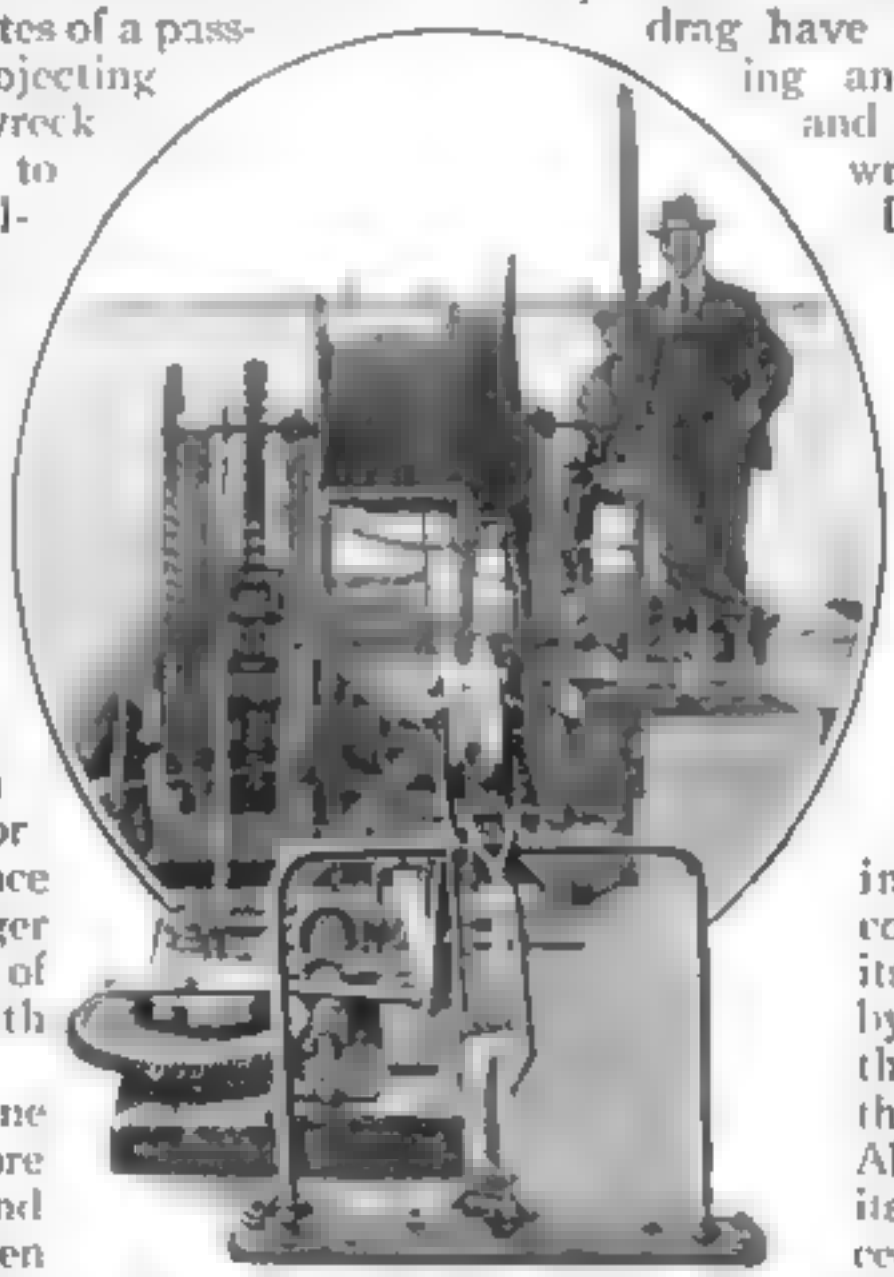
On a mariner's chart the line of soundings with the lead is represented by a row of figures spaced more or less closely together, and with the rows of numerals

representing depths spaced more or less widely apart, according to the depth and nature of the bottom. If the depths are great and the bottom of sand or mud, the lines and soundings are wide apart. If the depths are not great and the bottom rocky and broken, the soundings are closer together; but there is always a considerable interval between the lines of soundings and between the individual soundings. The soundings represent only the depth over a space of a few inches where the lead touched bottom. It is between the soundings that the danger may lie.

Thus, in the closest survey, large spaces are left, over which the depths are not absolutely known. Jagged pinnacles of rock projecting from the bottom may rip open the plates of a passing vessel. The projecting masts of a sunken wreck may be a menace to the navigator, although not visible above the surface. The lead may slide off a precipitous rock and give no indication of the true depth. A line of soundings has but one dimension, length. The wire-drag line has two dimensions, length and breadth. For every mile of distance dragged every danger in a square mile of area is detected with absolute certainty.

With the lead line their discovery is more or less a chance, and it is difficult and often well nigh impossible, to find a rock or shoal of small extent even when its approximate position is known. The vessel searching for it is as apt to run against the obstruction as to find it by sounding. With the drag such a danger cannot escape. Hence it is the only means of finding all submerged dangers in certain areas. Safety of navigation can be assured by no other means.

The wire-drag is operated in the following manner: A horizontal wire supported at any desired depth in the water by a system of uprights attached to floats at the surface and held down by weights, is drawn through the water by power boats. Any rock or shoal projecting from the bottom above the effective depth at which the drag is set is caught by the wire. Soundings are then taken over the spot, and its position is located by angles taken to previously determined points on shore. The soundings are afterward plotted and placed upon the charts. In practice the drag has developed into a somewhat complicated mechanism, but in emergencies a simple form of drag may be readily improvised. Modified forms of the drag have been used for finding and removing mines, and for locating sunken wrecks and buoys. It is obviously adapted to many such uses.

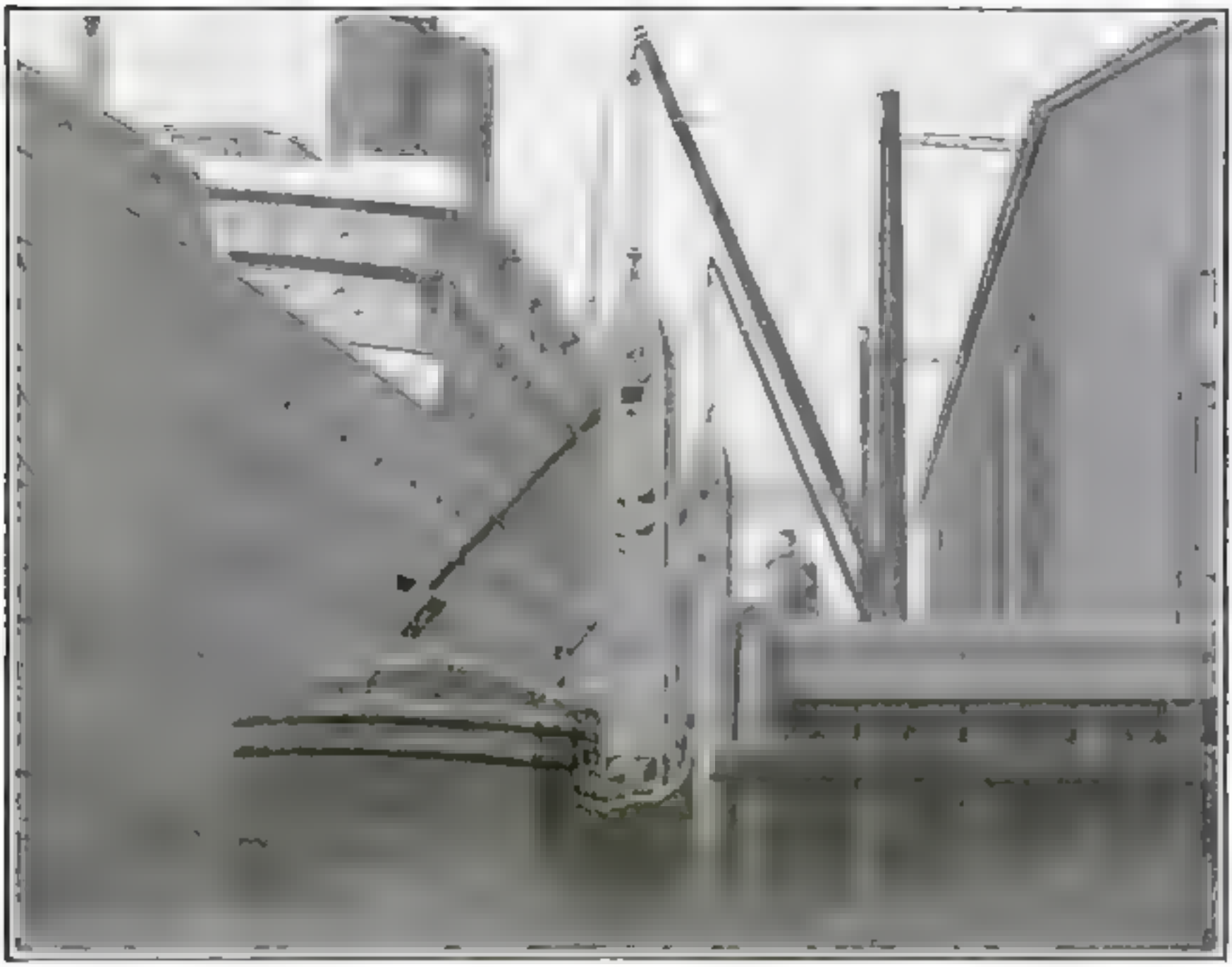


The hoisting and measuring equipment on the towing launch

The average cost of a wire-drag party is thirty thousand dollars, based on a season's work of from six to eight months. The cost per day is about two hundred and fifty dollars.

Some idea of the importance to this country of surveys of its coasts may be gained by recalling to mind that the coast line of the United States and Alaska, measured along its general trend, exceeds eleven thousand five hundred miles in length. To represent the actual shore line which must be surveyed and which includes all the islands, bays, sounds, and rivers in the tidal belt, these figures reach the large total of ninety-one thousand miles; and to this must be added the shore line of Porto Rico, Guam, Tutuila, the Hawaiian and the Philippine Islands, whose coast line is twelve thousand statute miles.

Coaling a Liner with an Elevator



An endless bucket-chain passes into the barge and thence up the conveyor to the discharging point at the top of the chute. This loader has coaled the "Vaterland" in twenty-one hours

SPEED and certainty are the two principals upon which the great steamships which ply between continents are operated. They are permitted only a limited number of days in port; they must be swiftly unloaded and cleaned; and they must be no less swiftly loaded, and made ready for sea. In all these operations, the machine which is in greatest demand is the one that can put the cargo aboard in less time and at less expense than another machine. Especially is this true in taking aboard coal. The ocean greyhounds which carry from five thousand tons to nine thousand tons of coal, and which are permitted only two or three days to take on such an immense cargo, must therefore be loaded in the most rapid as well as the most economical way.

Coaling ships by the old-fashioned hoist-operated tubs was a slow and expensive process. An apparatus was therefore made necessary which would reduce the coaling period, require less space, cut down the labor and maintenance costs, and eliminate the nuisance of flying coal-dirt. The machine that was invented with these objects in view is seen in the illustration loading coal from the barge into the port-holes of a large ocean liner. Each of these loaders can be suspended from a boom by means of a rope and pulley, over any barge, and inasmuch as they are truly portable, they can be swung from any portion of the ship to the desired loading point. Herein lies their advantage over the floating unloading elevators which require a large water space, and have but one point of delivery.

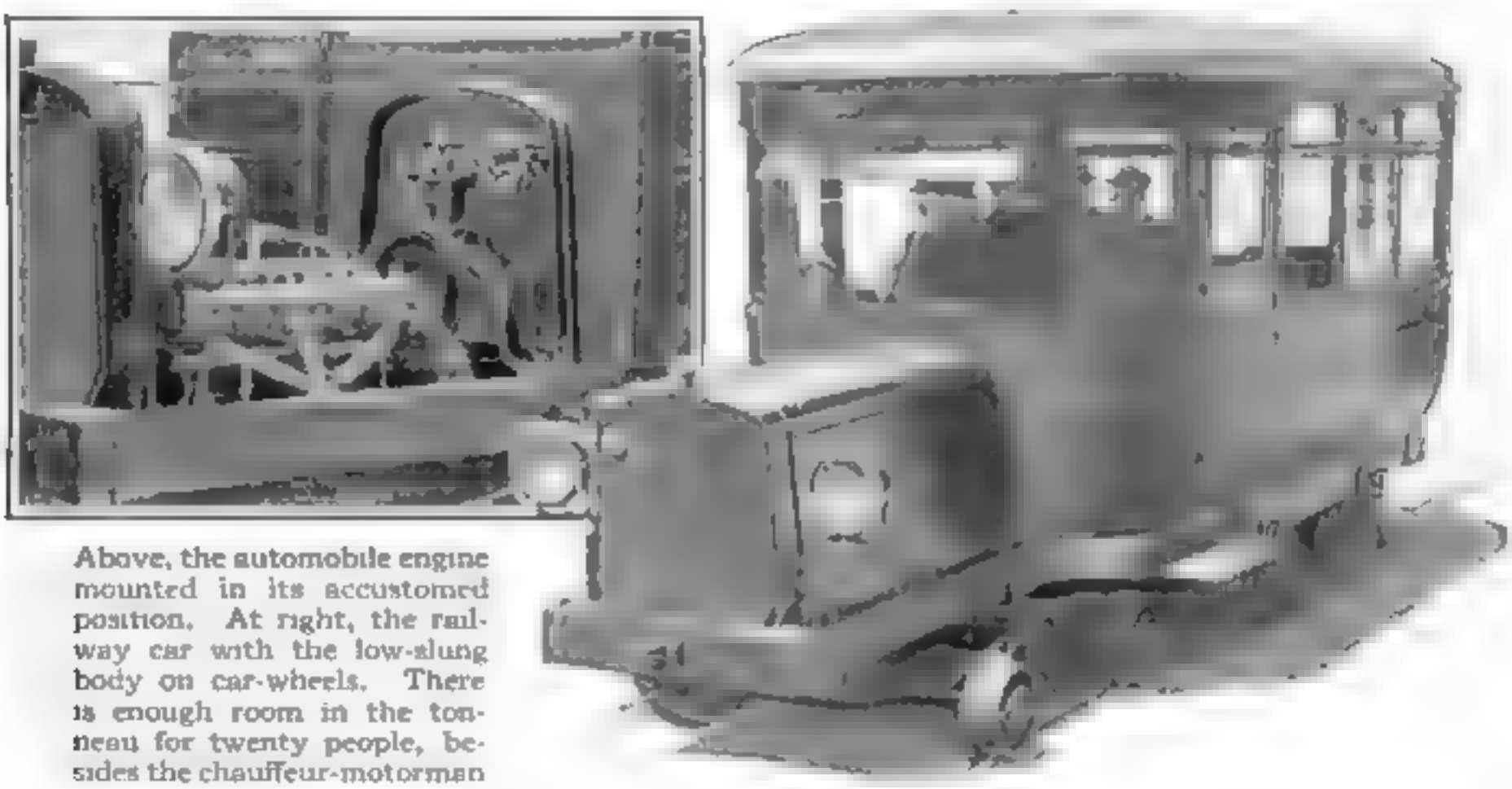
The driving-motor is installed in the head of the elevator, and is operated by electric current supplied from shore.

The starting and stopping of the elevator as well as the hoisting, shifting, and lowering of the unloaders is controlled by two men, one on each side of the vessel. On very large liners as many as twelve or fourteen of these electric loaders are employed for rushing the coal into the holds of these impatient monsters. And even when a fresh bargeful of coal is brought up, there is no delay in the operations; the loaders are simply raised and swung over the coal in the barge, and the loading continues.

What contributes most essentially to the effectiveness of these portable loaders, is the fact that they are self-contained. Within the elevator, steel buckets are connected with rolled steel hinge-pins, so as to form an endless chain. The chute, on account of its telescopic construction, is adjustable to the desired length, and distribution is thus made flexible. Such floating marvels as the "Imperator" and the "Vaterland" have been coaled by these loaders in twenty-one hours, during which eight thousand five hundred tons were put aboard by ten such machines—a performance that could not have been achieved by the old-fashioned system of hoisted buckets.

Any bulk material, such as sand, gravel, or stone may be loaded or unloaded from one point to another, rapidly and economically. These electric loaders are used to transport a cargo from a freight-car into a truck; or from a barge into storage bins. And when one considers that none of the material loaded is lost, and that the skilled labor of an engineer or his assistants is not needed to operate this device, its claim to economy becomes undeniable.

An Auto Mountain Railway



Above, the automobile engine mounted in its accustomed position. At right, the railway car with the low-slung body on car-wheels. There is enough room in the tonneau for twenty people, besides the chauffeur-motorman

FOR the transportation of passengers up Mount Tamalpais in California a number of automobile railway cars of unique design have been devised. The cars are propelled by a sixty-horsepower, water-cooled engine, and there is room in the spacious tonneau for twenty people, in addition to the driver.

The chassis, which is of special design, is mounted on railway car-wheels forming four trucks in all. A special gear-reducing mechanism cuts the speed of the engine down to where it is most efficient for climbing steep mountain grades. The seats are upholstered similar to those in railway cars, and everything possible has been done to cater to the comfort of the passengers. It is said that this method of transportation has enjoyed great popularity.

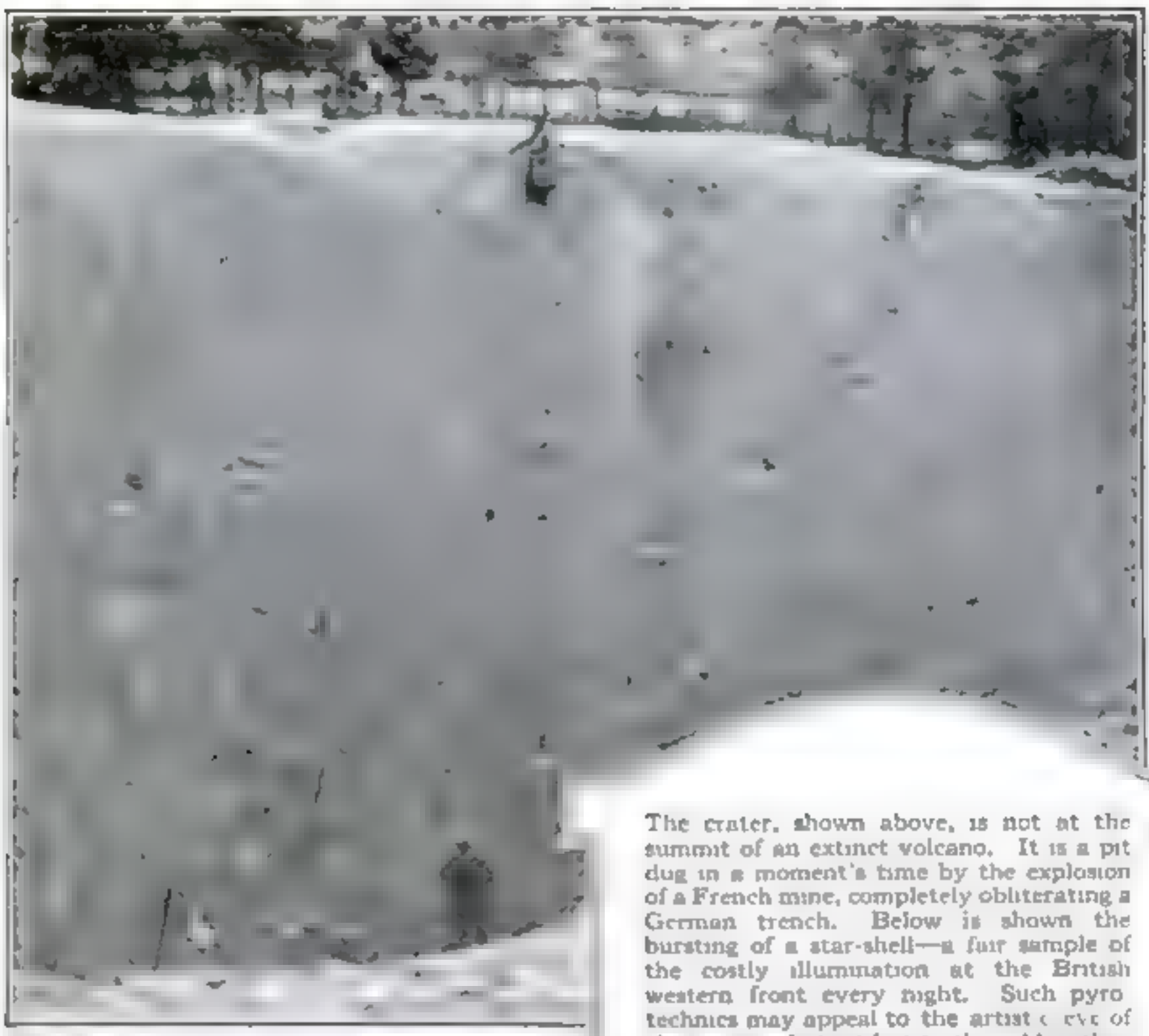
Experimenting with Liquid Fire

© Medem Photo Service

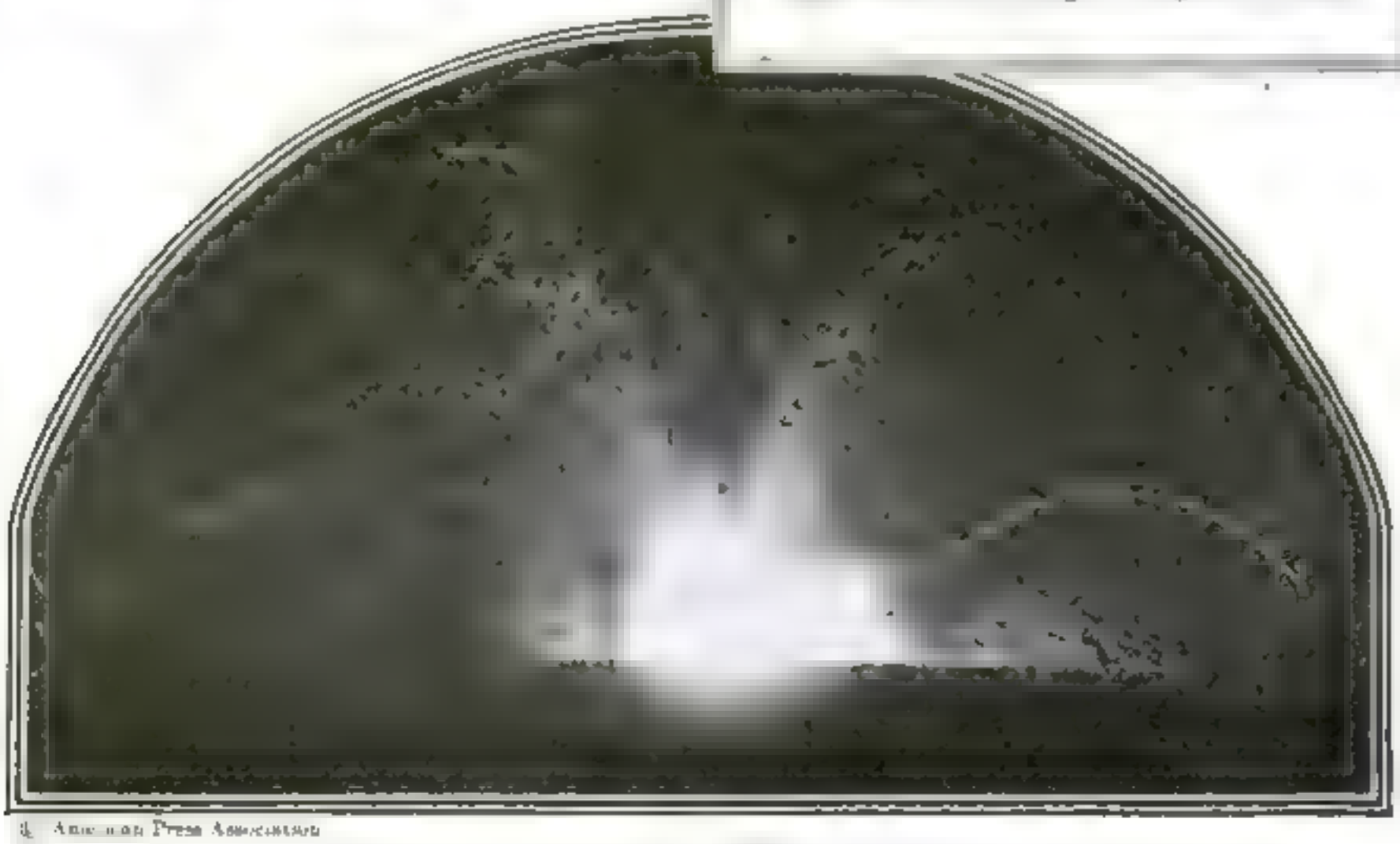
The deadly effects of liquid fire—a formidable factor of the present European conflict—are here being tested. The apparatus is strapped to the shoulder and the liquid is ejected through a hose

A few minutes after the capture of the German trenches at St Eloi. The soldiers are members of the British "Fighting Fifth." They are wearing the new English steel helmets which are flatter than the French helmets. The weapons displayed are captured trench guns

What Chemical Energy Can Do



The crater, shown above, is not at the summit of an extinct volcano. It is a pit dug in a moment's time by the explosion of a French mine, completely obliterating a German trench. Below is shown the bursting of a star-shell—a fair sample of the costly illumination at the British western front every night. Such pyrotechnics may appeal to the artist's eye of the non-combatant but to the soldier they mean but one thing a night of terror



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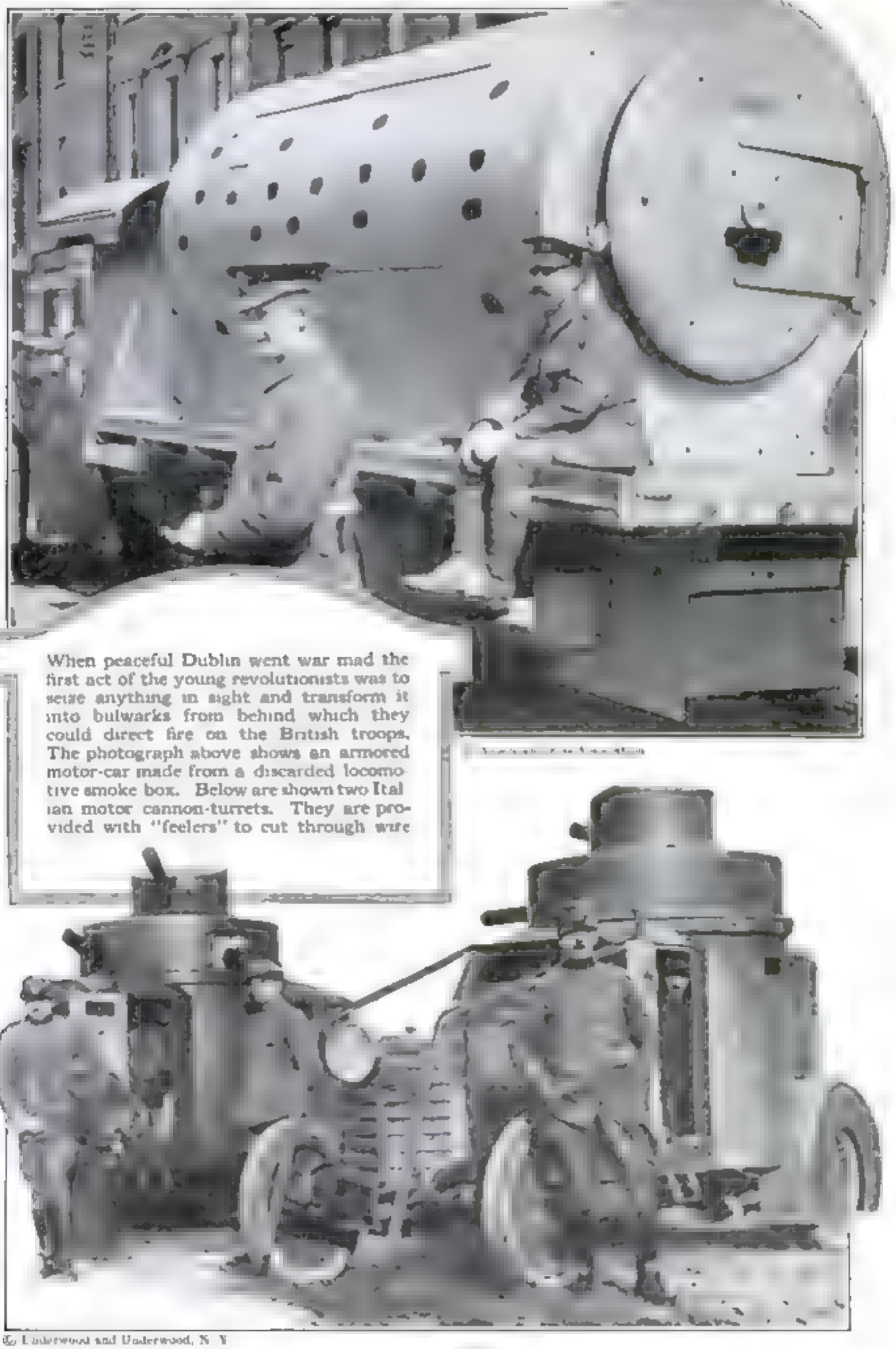
Infernal Devices of War-Crazed Men



When peaceful Dublin went war mad the first act of the young revolutionists was to seize anything in sight and transform it into bulwarks from behind which they could direct fire on the British troops. The photograph above shows an armored motor-car made from a discarded locomotive smoke box. Below are shown two Italian motor cannon-turrets. They are provided with "feelers" to cut through wire

Another Death in Germany's Aerial Family

The Zeppelin L 20 wrecked off the coast of Norway It is said to have been one of the five or six Zeppelins which took part in the raid on the East Coast of England the night of May 2. It was driven about by the wind and finally settled in the water where it broke in two and sank. The crew escaped by jumping just before the cabins struck the water

A view of the Zeppelin shortly before it sank. The afterbody broke just ahead of the aftercabin and disappeared When the big ship hit the water the wind soon buffeted it about so roughly that it was torn to pieces. A shortage of fuel is said to have caused its loss

War Machines of the Atmosphere

The boat-like after cabin of a Zeppelin, showing the spacious quarters for the crew

A powerful aeroplane motor which has just arrived in a French camp in Macedonia, being tried out by aviation officers prior to its practical war service

Photos © Underwood and Underwood, N Y

French soldiers about to raise a complex observation kite at the Verdun front

Animals Highly Valued in War

© Underwood and Underwood, N. Y.

Mules are treated with great care in Albania and are carried across deep streams on ferries. Horses swim their way across

A trainload of camels leaving Cairo for the western frontier of Egypt, where they constitute the Imperial Camel Corps

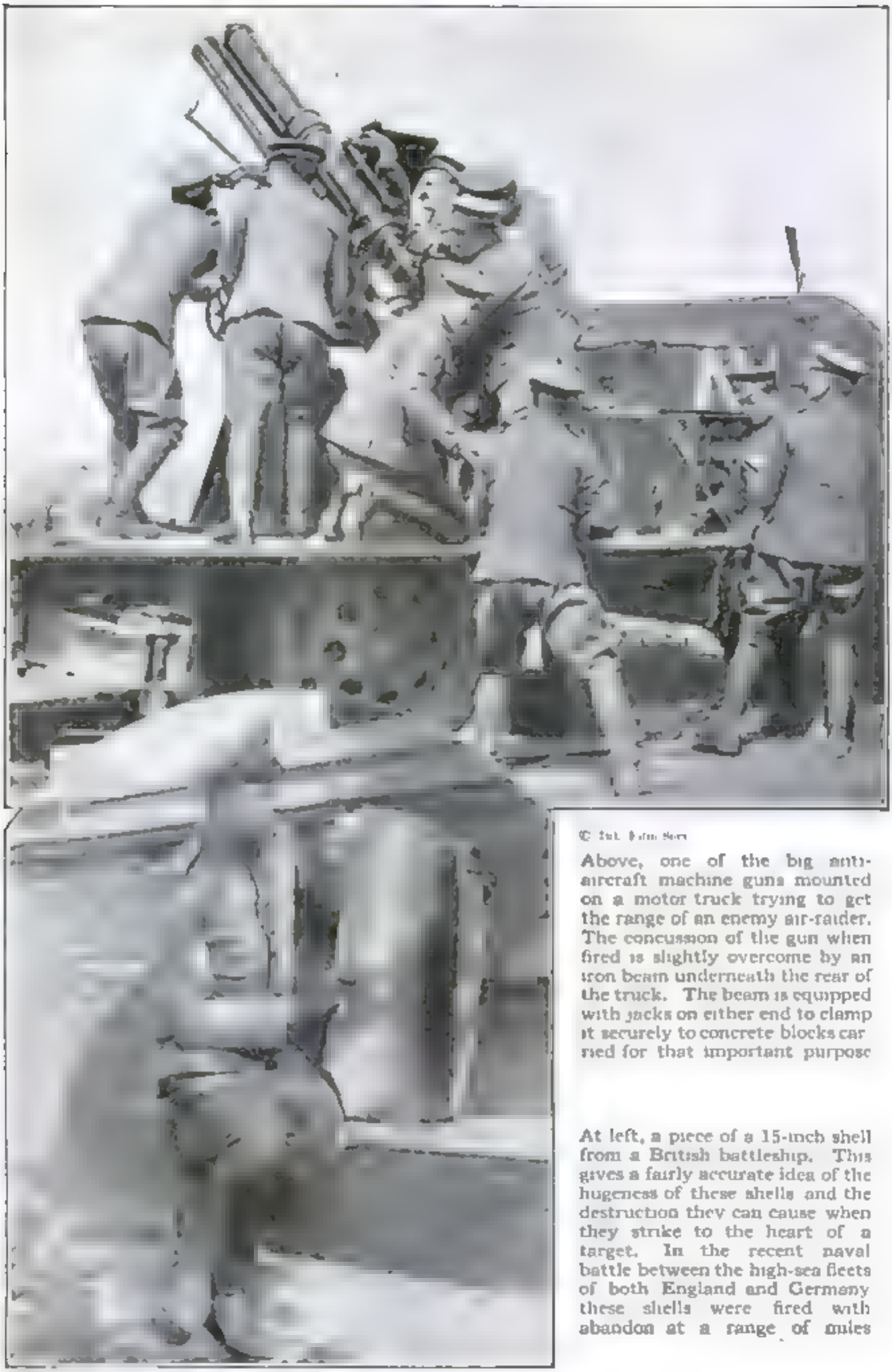
© Int. Film Serv.

British Balloon for Reconnoitering in Greece

A British kite balloon on the balloon deck of a war transport. On the right is a wind screen and in front is a special sliding platform to facilitate the movement of the bag. The balloon is carried in the hold of the ship and is released when conditions are favorable for reconnoitering

The illustration below shows a kite balloon rising from the deck of its transport to make a reconnaissance tour of the country surrounding Salonika. The balloon is invisible to enemy airmen when it is being transported from place to place in the vitals of the big war transport

Science Is Terrible, When Applied to War



Above, one of the big anti-aircraft machine guns mounted on a motor truck trying to get the range of an enemy air-raider. The concussion of the gun when fired is slightly overcome by an iron beam underneath the rear of the truck. The beam is equipped with jacks on either end to clamp it securely to concrete blocks carried for that important purpose

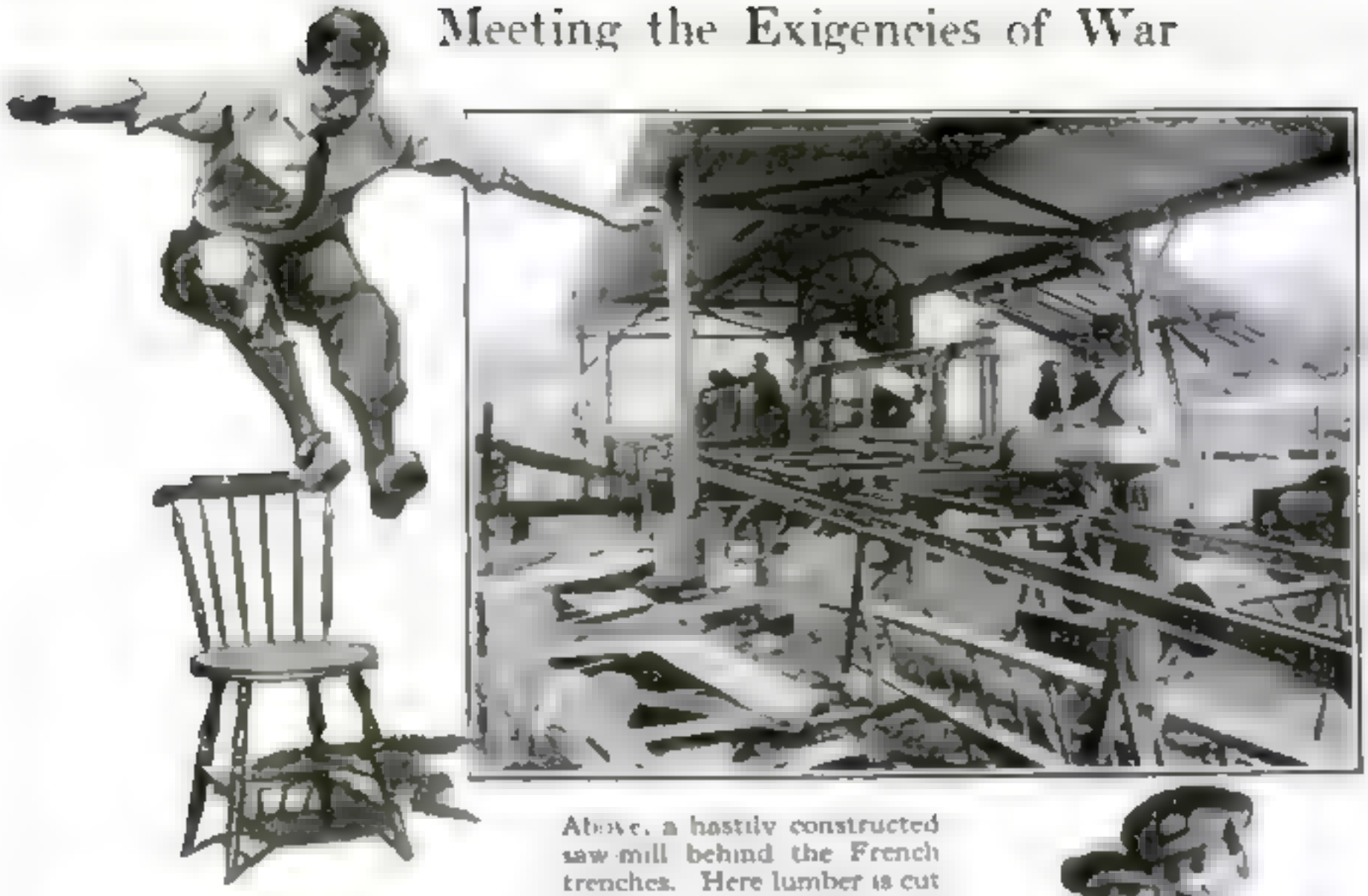
At left, a piece of a 15-inch shell from a British battleship. This gives a fairly accurate idea of the hugeness of these shells and the destruction they can cause when they strike to the heart of a target. In the recent naval battle between the high-sea fleets of both England and Germany these shells were fired with abandon at a range of miles

Economy Born of Necessity

A group of hungry people around a soup caldron in Berlin waiting their turn to procure their portion of soup which is sold for thirty-five pfennings (about 8½c.) a helping

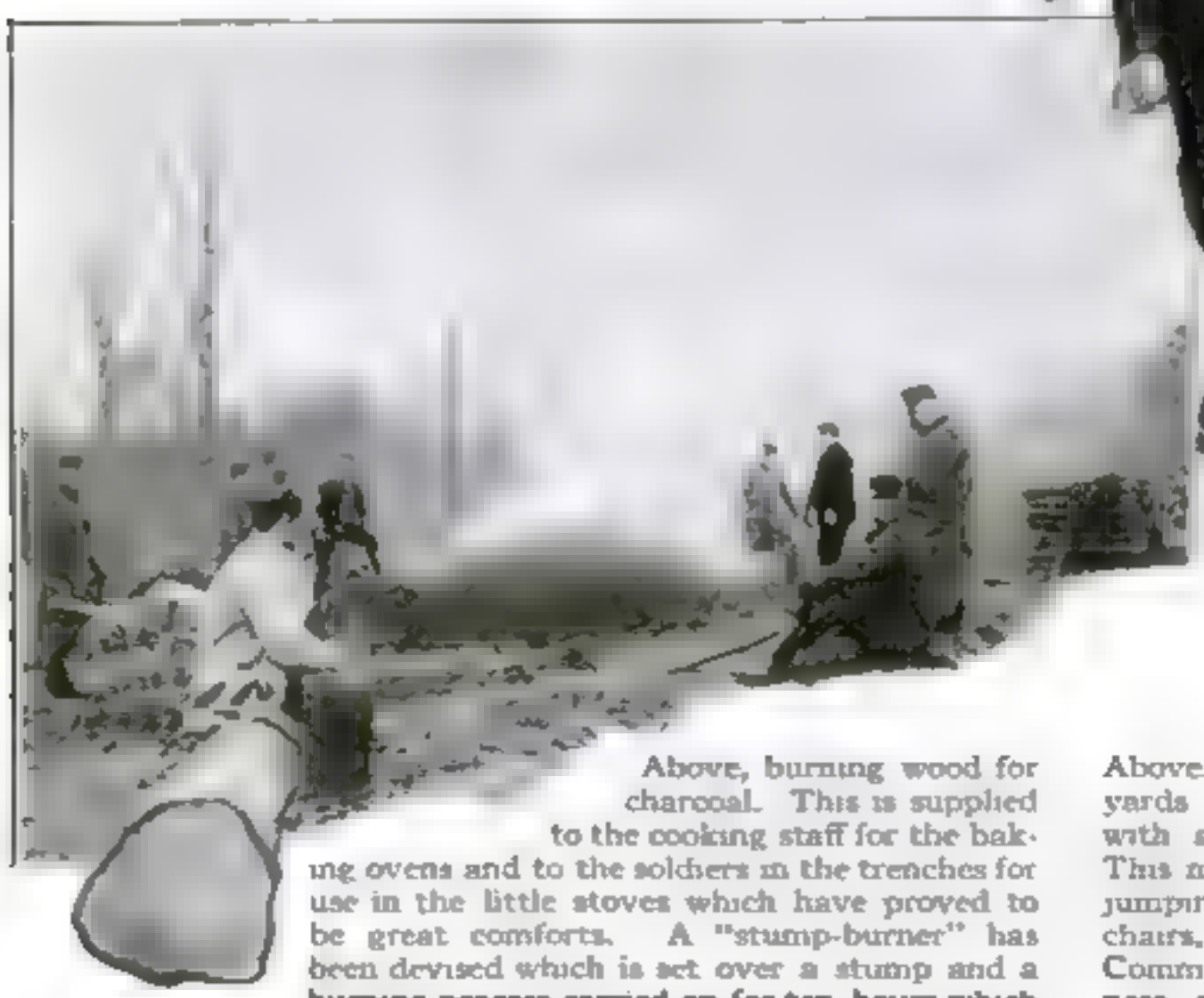
At right, stripping a Berlin building of copper for ammunition purposes. The thrifty German hausfrau long ago contributed her copper cooking utensils to the country's cause

Meeting the Exigencies of War



Wounded Tommies who will fight the battle of life hereafter with artificial limbs held an athletic meet at Roehampton recently. This fellow's right leg below the knee is artificial, but he cleared the chair with ease

Above, a hastily constructed saw-mill behind the French trenches. Here lumber is cut for the various uses of trench life. Impromptu huts are built of it and it is much in demand for mining and timbering the dugouts which are in French hands today but which may be German inhabited in another twelve hours



Above, burning wood for charcoal. This is supplied to the cooking staff for the baking ovens and to the soldiers in the trenches for use in the little stoves which have proved to be great comforts. A "stump-burner" has been devised which is set over a stump and a burning process carried on for ten hours which reduces the stump to charcoal and heavy oils

Above, running a hundred yards in thirteen seconds with an artificial right leg This man did the trick after jumping over a half-dozen chairs, one after another Commuters who make a business of running for trains would be proud of this record

Our Boys in Mexico

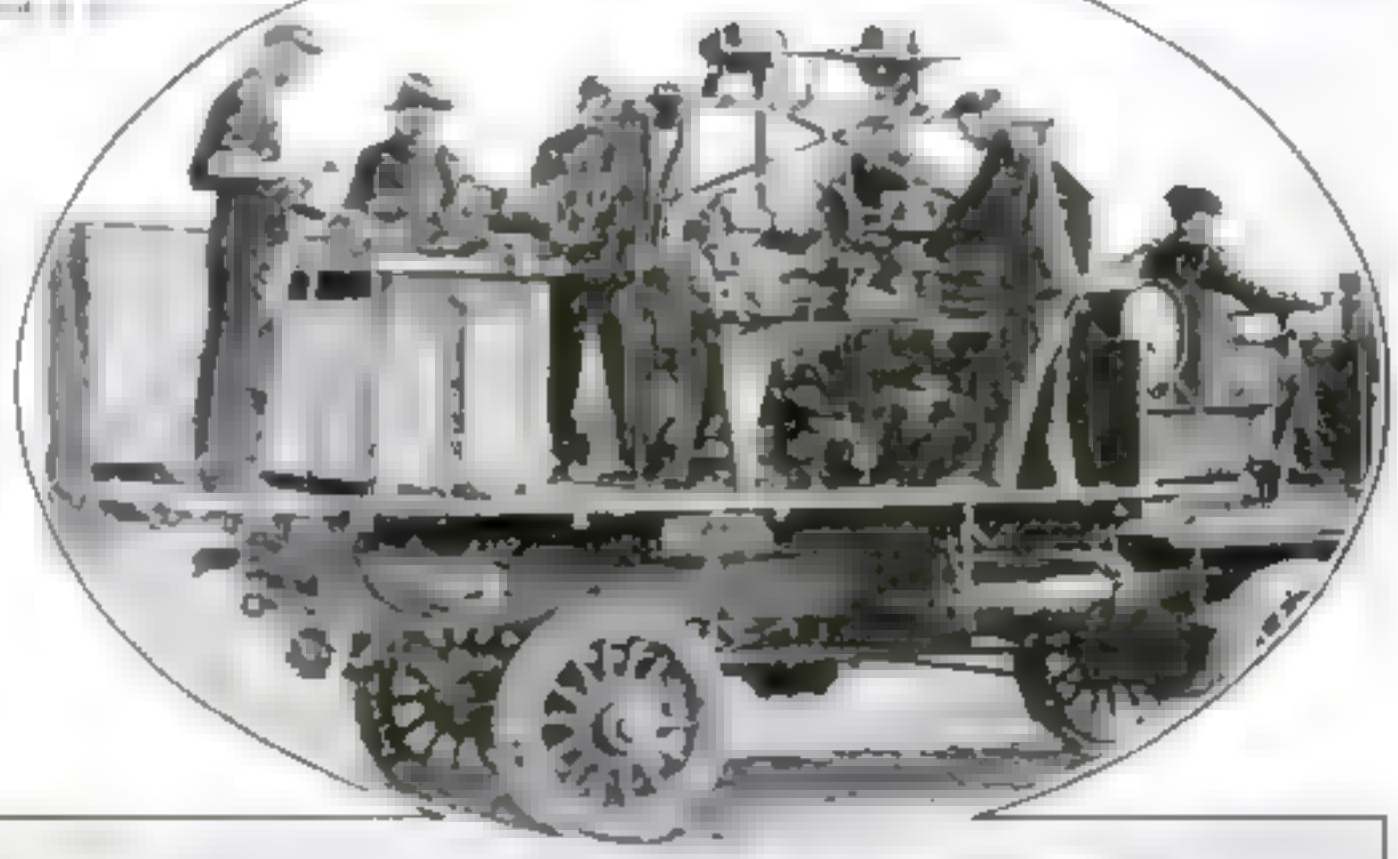
More American troops arrive at the border to take the place of those sent on with the Punitive Expedition into Mexico. At left, transporting United States artillery and supplies over Mexico's roadless hills

© Underwood and Underwood, N Y

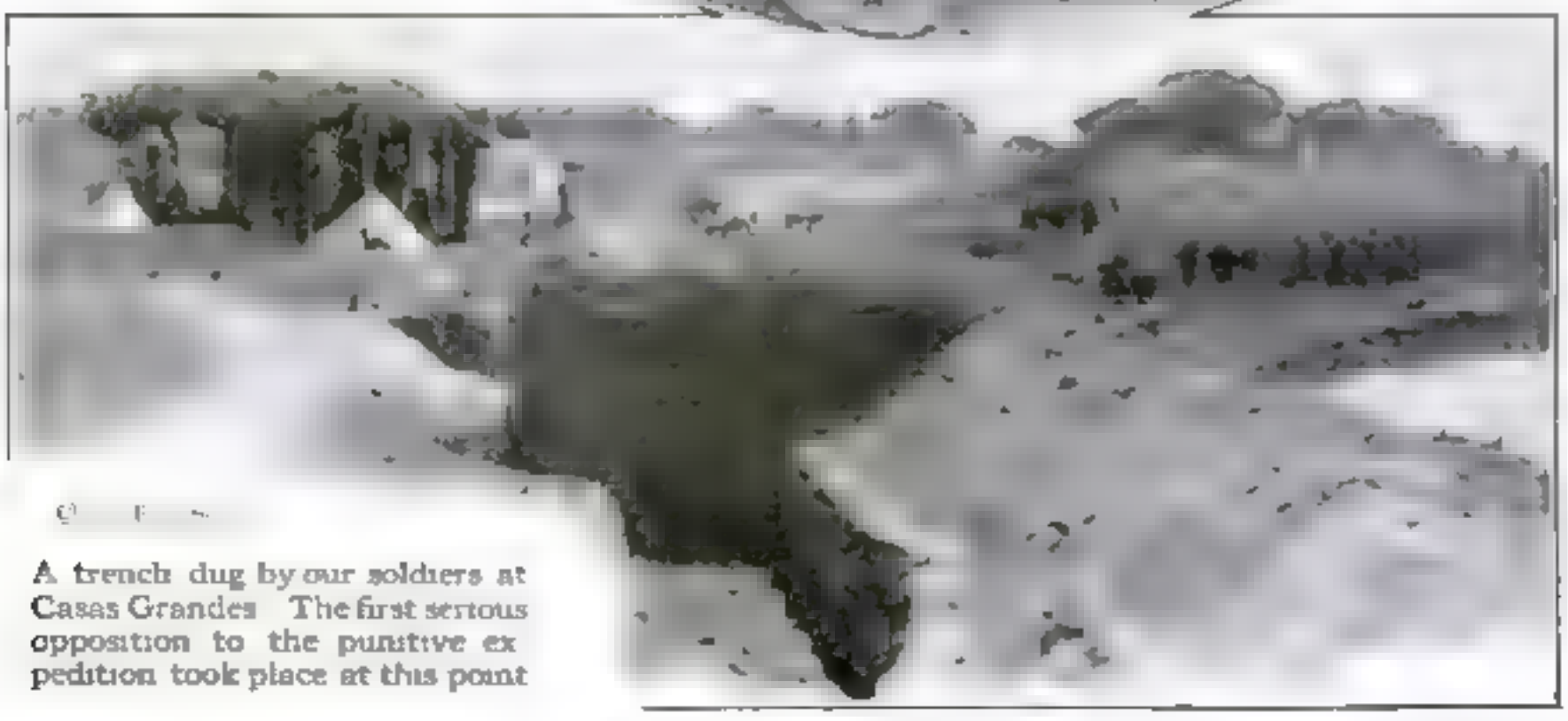
Dismantling the First Aero Squadron for shipment to the border Within a few weeks this squadron was again dismantled—hopelessly. Of our light aeroplanes, not one remained in flying condition. A few more machines were sent to take their places, but the entire Aero Squadron is composed of a fewer number of machines than is destroyed in a week's warfare in Europe. It must be said, however, that our fliers have accomplished marvels with their limited resources. From the first they have carried important dispatches between headquarters

Our Man-Hunting Expedition in Mexico

Below, a group of youthful soldiers who are doing their part to capture Villa. A large part of the expeditionary force is now made up of young men like these

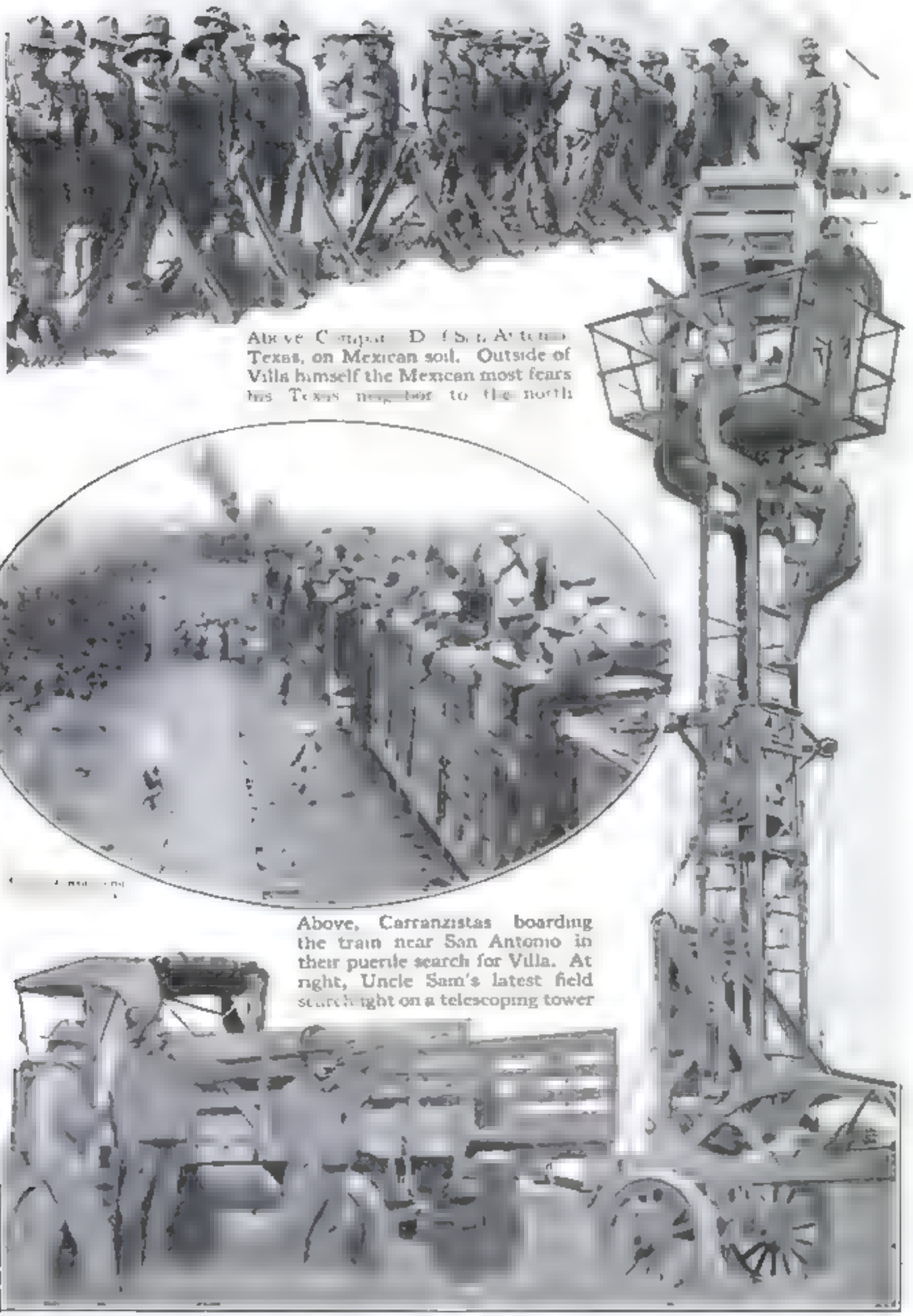


At right, one of the repair shops on wheels in Mexico. A complete lathe and turning equipment is operated by motor and dynamo, driven directly from the automobile engine



A trench dug by our soldiers at Casas Grandes The first serious opposition to the punitive expedition took place at this point

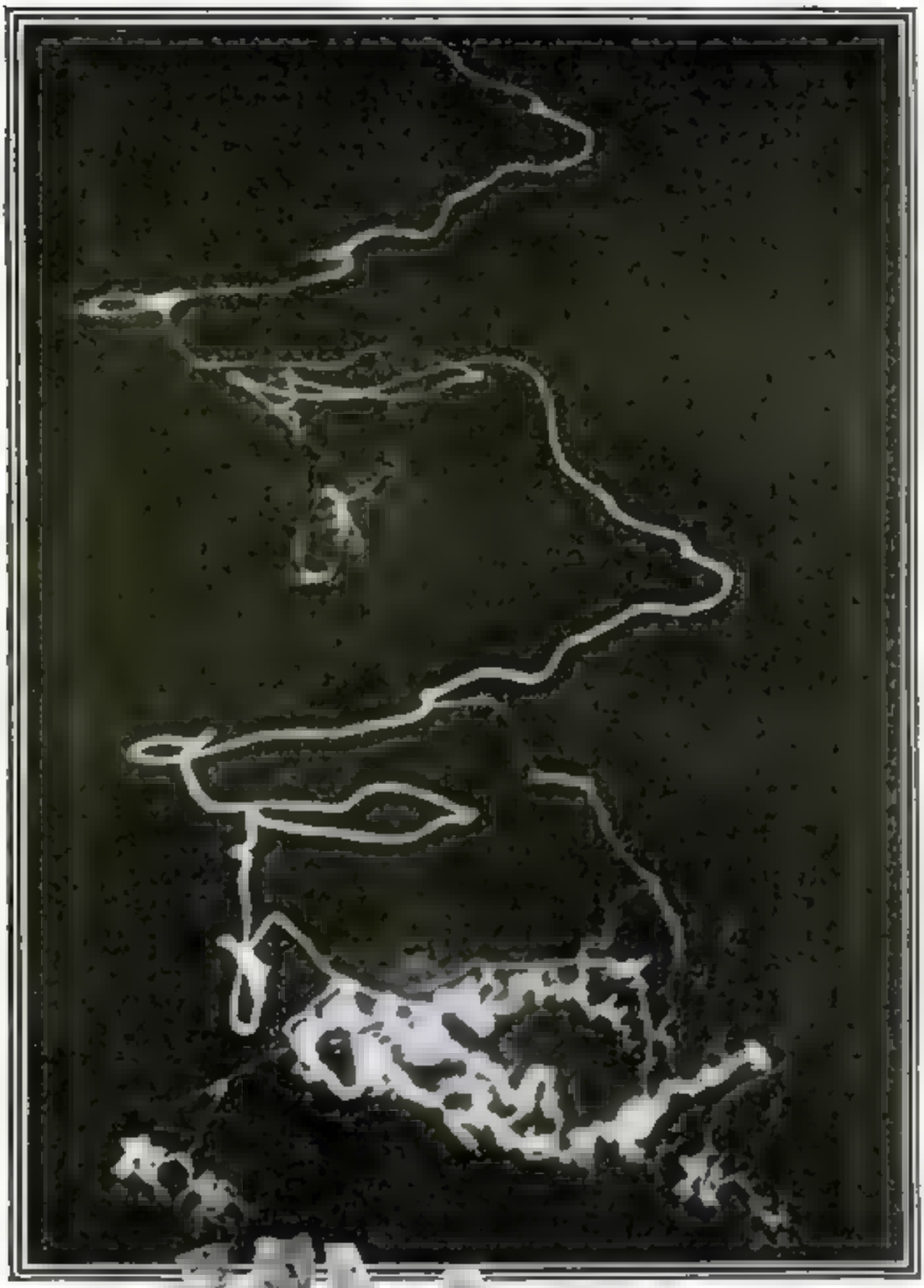
Which Is Rounding Out Its Fourth Month



Above, Company D of San Antonio, Texas, on Mexican soil. Outside of Villa himself the Mexican most fears his Texas neighbor to the north

Above, Carranzistas boarding the train near San Antonio in their puerile search for Villa. At right, Uncle Sam's latest field searchlight on a telescoping tower

Exhibiting Our Army's Efficiency at the



A daring girl aviator, Miss Katherine Stinson, performed several tricks in a night aeroplane flight at Sheepshead Bay, New York She dropped a number of bombs which exploded a thousand feet over Coney Island to give the pleasure seekers all the thrills of a real bombardment Two bomb explosions show in the lower left hand corner of the illustration

The first armored motor battery presented to the New York National Guard received its initial tryout at the Sheepshead Bay Tournament recently Before a great assemblage of interested spectators the battery crew gave an exhibition, firing the guns and going through maneuvers which would be expected of them in actual war

© Underwood and Underwood, N. Y.

War Maneuvers at Sheepshead Bay, New York

© American Press Association

At the Sheepshead Bay Army and Navy Tournament Rodman Law exploded his balloon with a stick of dynamite and descended safely to earth in a parachute

© Underwood and Underwood, N. Y.

Above, at the same tournament the first automobile-drawn field artillery unit made its official début

Turning Your Racket-Press Into a Camp Stool

A CASE or press for a tennis racket that may be turned into a seat or stool at the discretion of the player is the invention of an Illinois man. The idea is to utilize the press as a seat in addition to its being used as a frame for the racket to hold the latter in the proper position to prevent it from warping.

Eight bars depending from the press are the legs for the stool device and when spread they afford a seat strong enough for the heaviest man. The apparatus is so arranged that the legs can act as supporting posts for the racket when it is held in an upright position on the ground.

The press may hold the racket or be spread out as a seat for the tennis player

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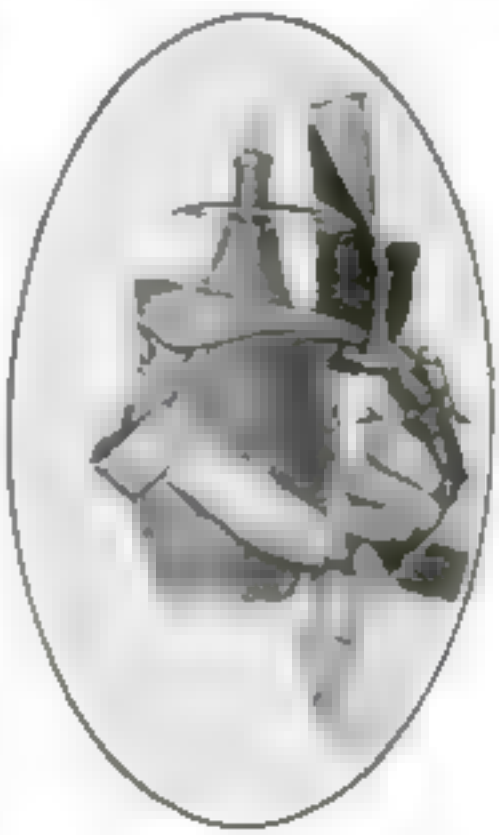
An Old Lamp Used by Rubber Gatherers in Brazilian Jungles

THE Brazilian rubber gatherer, far from civilization on the tributaries of the upper Amazon, is often compelled to use his ingenuity to improvise substitutes for the articles which he cannot obtain. This lamp was constructed out of an old gunpowder flask, cutting the handle and reflector from an empty kerosene can. The wick is made from a piece of gunny sack. With this crude device the native lights his path through the jungle when making his nightly rounds to collect the milk from the rubber trees he is tapping. When he desires a light for his hut, which is upon rare occasions, he uses the old powder flask lamp, burning it sparingly.



A lamp made from an old powder flask

Where Freckles Come From and Why They Stay

A BEAUTIFUL face is a silent recommendation and an index to your state of happiness and health. Even the most peach-like skin proves to be a pleasing background for a dainty brown mole or "beauty-spot." But there are blemishes and blemishes.

What is usually spoken of as freckles are spots of yellowish-brown color. Especially after the skin has been exposed to the sun for a long while do freckles make their unhappy appearance. They are as unwelcome as weeds, and as stubborn as the mule Maud. The face, neck, and hands are molested mostly, for they are much exposed to the sun and are unprotected by clothes. Some people are much more liable than others to suffer these blemishes, and in some they disappear quite quickly, while in others they last a long time.

However, in most instances, freckles are the result of the action of the sun on certain cells of the skin, which causes these cells to produce coloring matter, or pigment, which remains there for a long time. Sometimes freckles do not appear to be caused by very hot sunshine or exposure, but just seem to come naturally, just as the color of the skin is either fair or dark, according to the tendency inherited by the individual.

No matter how the gorgeous illuminations of a toilet-articles counter may appeal to you, or how the delicate perfumes of ready-made toilet lotions and freckle-removers lure you, the best advice is to shun them.

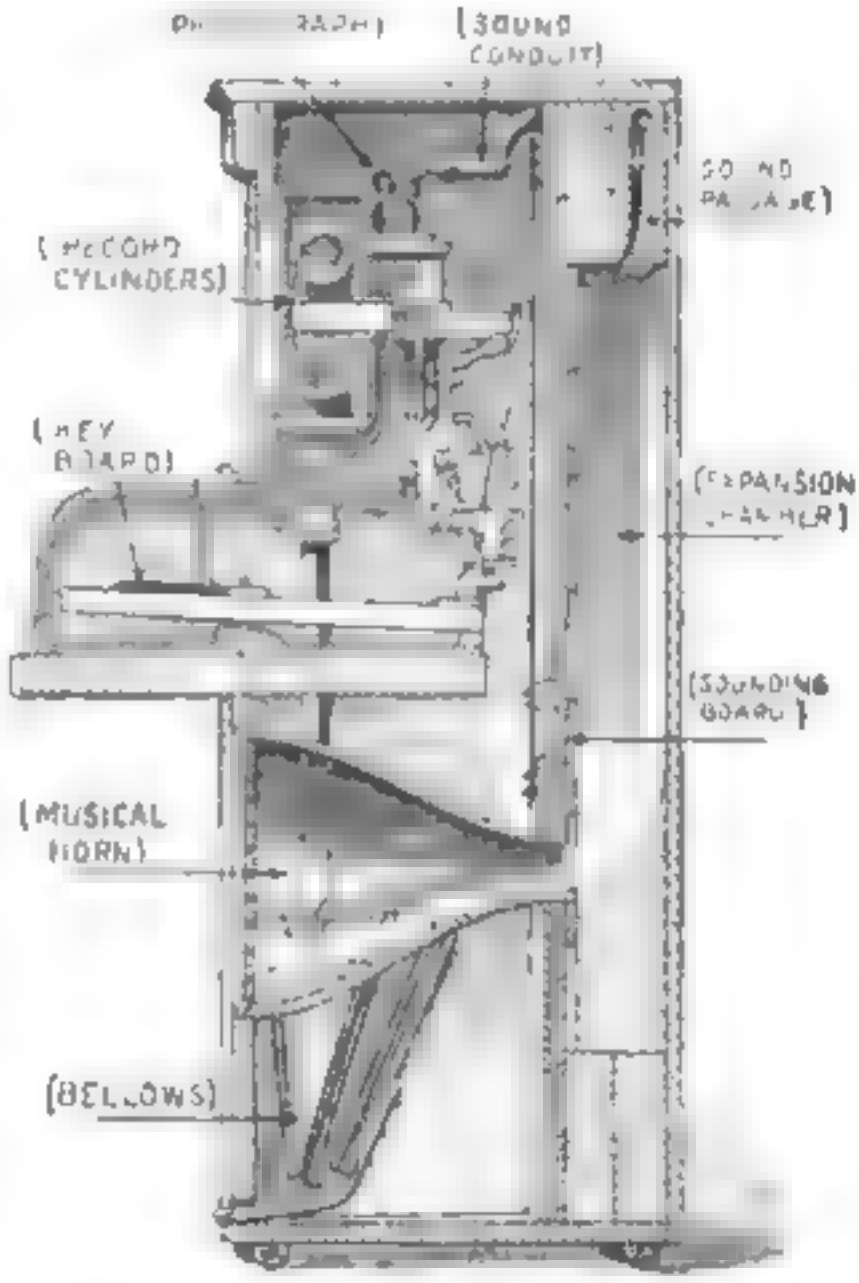
Piano and Phonograph Combined

MANY attempts have been made to construct an instrument that would successfully reproduce at the same time phonograph and piano music. Edwin S. Votey of New Jersey has taken out patents on an instrument which he believes meets all requirements. His invention comprises a piano or player-piano with an opening in the wall of the casing for a phonograph or any record-controlled mechanism for the reproduction of the human voice, and a sound-blending chamber in the rear of the sounding-board into which the sounds from the phonograph as well as of the piano mingle for the purpose of producing harmonious effects.

The phonograph is mounted in the upper part of the casing of the piano and is provided with an opening in the front of the piano for the placing of records on the machine. For the sake of neatness of design and symmetry this opening is duplicated on the opposite side of the piano. Back of the sounding-board is an expansion chamber or sound-blending chamber into which the music from the phonograph is carried by means of a flexible sound-conduit leading from the phonograph to the sound-chamber.

The lower ends of the sound-chamber converge downward and at the lowermost extremity an outlet is provided in the shape of a horn attached to the front casing of the piano, with its opening closed by lattice work or a screen. The conduit, passage-way, sound-blending chamber and horn taken together constitute a sound-conducting passage.

In operation a record is placed upon the phonograph, which is wound through the doors. The perforated music-sheet is placed with the mechanism of the piano and the instruments are ready to play. The phonograph is started and with it the piano, both of them by hand in the usual manner, care being taken to start the piano so that it will commence playing as nearly as possible at a certain point with the phonograph. The music having begun, the musical time of the piano is adjusted by means of a tempo-lever to accord with the musical time of the phonograph. Thus the two instruments are made to play together in the same musical time.



The piano and phonograph are made to play together in the same musical time

Curious Set of Features Are New Markings on Mars

DR. PERCIVAL LOWELL announces from his Flagstaff Observatory that a curious set of features, secondary to the main canal network, have become apparent on Mars. Within some of the polygons made by the intersections of the larger canals a tiny dot has been descried, joined to a corner and to the sides of the polygon by lines so slender they usually appear as a string of minute beads. The effect is of a centrally-woven web, spun within the borders of the polygon, of a more minute order of tenuity than the polygon itself. These details are so minute as to suggest a new order of Martian markings.

The World's Largest Ship's Register Chiseled in Rock

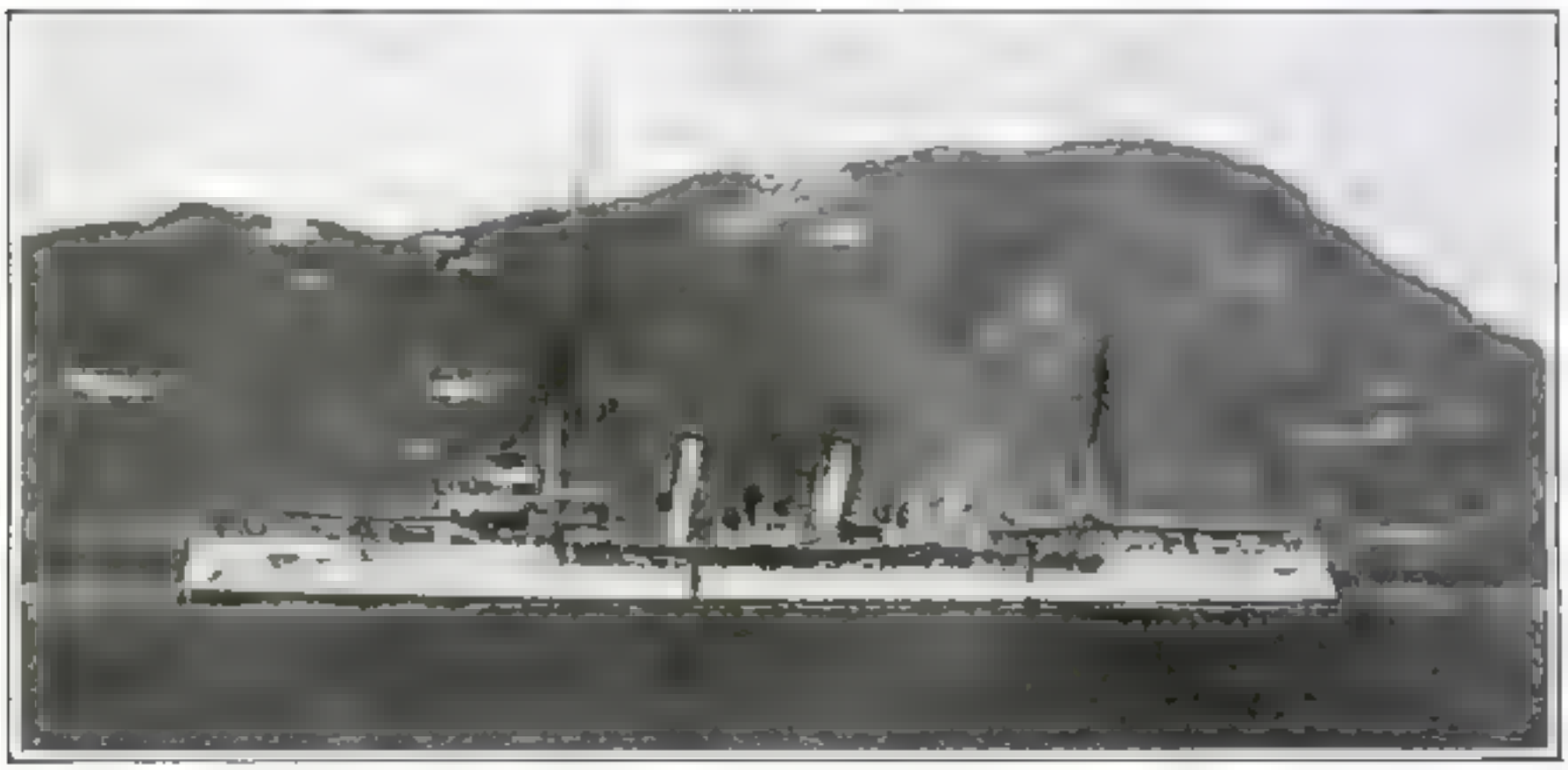
DOUBTLESS "Lloyd's" is larger in the sense that it contains a longer list of names, but on the score of sheer size there is nothing else in the world to compare with the great "Ship's Register" of the port of Muscat.

Muscat is the capital of the Sultanate of the same name which occupies the southeastern corner of the Arabian Peninsula, and from its position at the mouth of the Persian Gulf it has become a port of call for all vessels serving the Turkish and Persian coasts, as well as one of the stations for the British navy. In the early seventies the Yankee skipper of an East India-Boston clipper, which had been driven into Muscat by a storm, whiled away the day or two that his crew was busied with repairs by painting the name of his ship, the "Mary Wade," on the black basaltic rock of the hillside above the bay.

The striking effect of the large white letters against the dark background induced other skippers to follow suit, and it is said that very few indeed of the craft that have visited Muscat in the last three decades have failed to "leave their cards" on the hillside. The most imposing records are those left by the British men-of-war, the jackies of which have vied with each other in trying to make the name of their ship the most conspicuous. The names of the "Red-breast" and "Odin," which may be clearly seen in the photograph, are fifteen to twenty feet high in the original, and painted on carefully chiseled and smoothed stretches of rock. To an American the most interesting name is that of the "Isla de Luzon," painted in 1898 before that Spanish gunboat was captured by Dewey.

Firing with Heavy Artillery at an Enemy You Can't See

ARTILLERY fire is not unlike quarreling by telegraph, according to Dr. George W. Crile, an American physician who visited the fighting front and observed the behavior of men in the act of making war. "In contrast to the vis-a-vis trench fighting with rifles and hand grenades and dynamite," says he, ("A Mechanistic View of War and Peace," The Macmillan Company), "artillery fire is more severe only when concentrated, and the concussive effect of bursting shells brings other forms of injury. . . . The process is in a measure comparable to 'caisson disease' or 'bends' in workmen laboring under atmospheric pressure in tunnels under water. . . . The artillery man rarely sees the object of his fire; he has no personal contact with the enemy, but suddenly finds himself under a scorching fire, from a source which he cannot ascertain, from an enemy he cannot see. It is like quarreling by telegraph."



Few craft visiting Muscat have failed to "leave their cards" on the hillside. The names of the "Red-Breast" and "Odin" are from fifteen to twenty feet high chiseled in rock

The Submarine Blockade Runner

A U-Boat to Carry Contraband Cargos

THANKS to the control of the North Sea by the British fleet, the entire manufacturing world has been forced to realize its dependence upon Germany for many materials. Some coal-tar drugs, dyes, and the like are worth anywhere from ten dollars to one hundred dollars an ounce; others cannot be obtained at any price. Germany, on the other hand, is beginning to feel the pinch of want. Meat is so scarce that it may soon be worth dollars a pound. If it were only possible to run the blockade in and out of Germany, what a fortune could be made by selling coal-tar products in the United States and food in Germany!

Now it is obvious that the only successful way of escaping the blockade is to travel either above or below the vigilant British cruisers—travel in the air, or travel below the surface of the water. To carry even a few hundred pounds of freight through the air is out of the question. Neither the dirigible airship nor the aeroplane could ever make much money as a blockade runner, simply because of its limited carrying capacity.

But what of the submarine? What are the possibilities of carrying fairly large and extremely valuable cargos in under-sea craft?

At least one submarine designer apparently believes in the possibility. He is Simon Lake, one of the foremost authorities on submarine boat construction in this country. A few months ago, he patented a cargo-carrying submarine, the inspiration of which was probably given by the present war situation; for he says in his patent, "I provide an exceedingly novel construction of submarine or submergible boat particularly designed for carrying cargos of various descriptions, and which will be found of inestimable advantage in supplying blockaded countries with food-stuffs or war materials during hostilities, and which may be readily submerged, when upon the high seas, in the event of interception by an enemy's fleet."

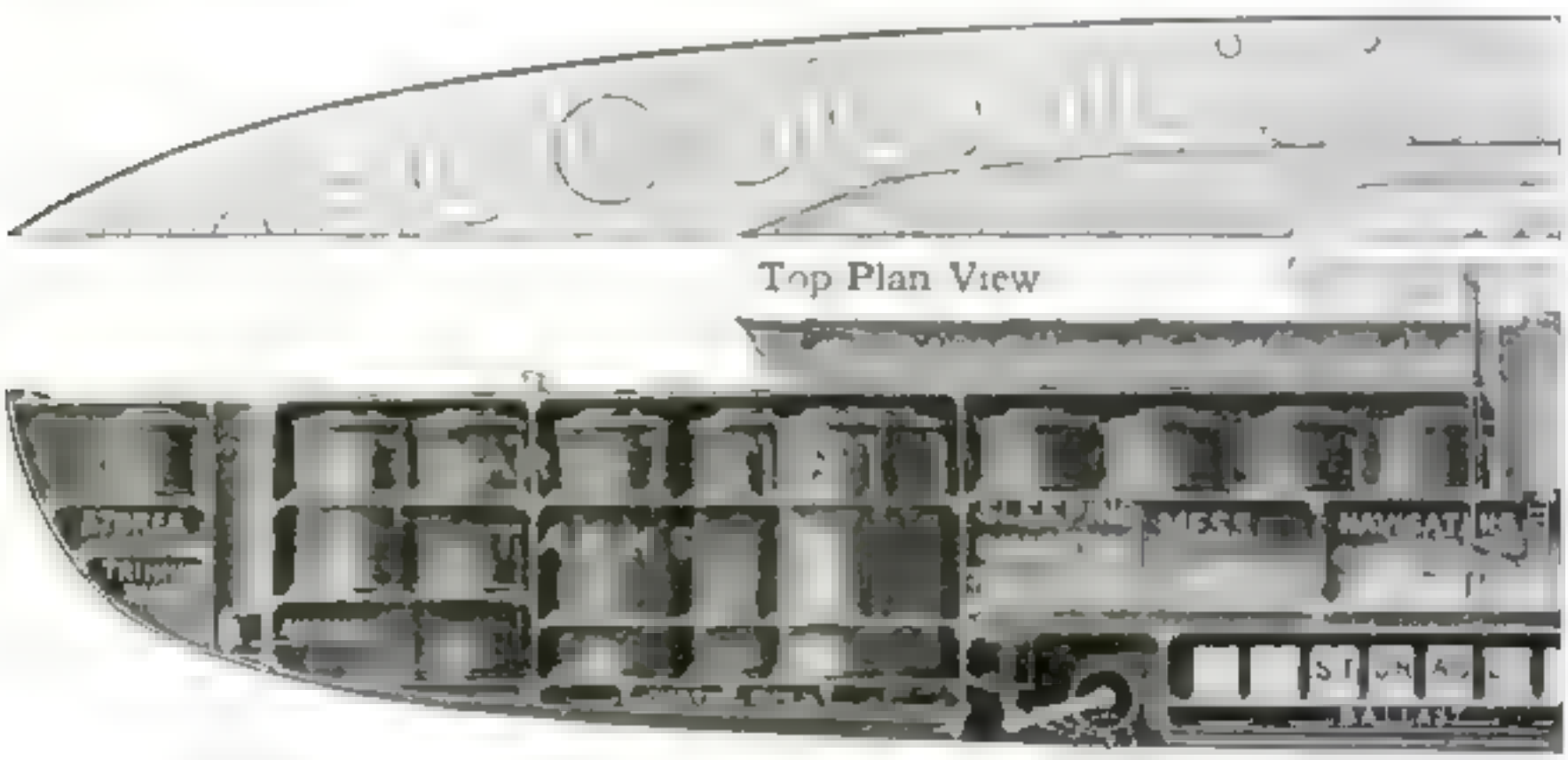
The construction of this cargo-carrying submarine of Mr. Lake's is utterly different from that of the familiar destroyer of battleships. Its external appearance is perhaps not so widely at variance with the accepted type, but its interior arrangements are in every way remarkable. The vessel which we picture would be at least 350 feet, and possibly 400 feet long, and would be able to carry about 5,000 tons of cargo.

To carry 5,000 tons at the surface, the vessel must be extraordinarily buoyant.

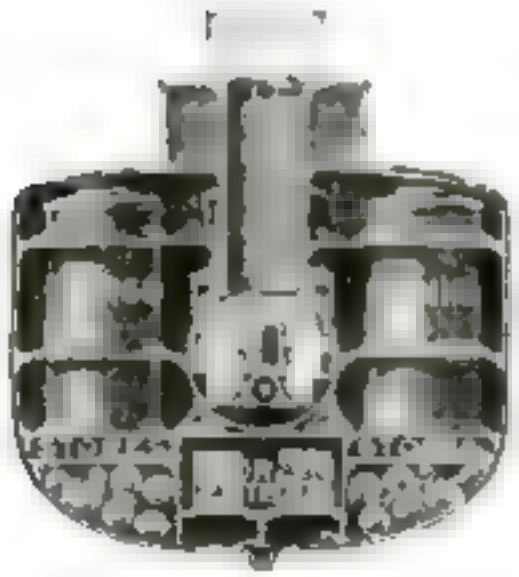
To attain that buoyancy is the chief problem of the designer of a cargo-carrying submarine. Let us see how Mr. Lake has solved this problem.

Study the accompanying drawings and you will notice that Mr. Lake's blockade runner consists of an outer hull and an inner hull. The outer hull resembles that of the ordinary surface vessel in all essentials. The inner hull is submerged. When the vessel is to rise, the sea water is pumped out. When the vessel is submerged, the cargo-carrying tanks are entirely surrounded by water.

The inner hull is pressure-resisting, the outer hull, non-pressure-resisting. The water-tight cargo tanks are obviously set in compartments which may be regarded as water-ballast compartments. These are filled during submergence and



Top Plan View



A Submarine Blockade Runner Which Could

Newspapers have had much to say of a mysterious German cargo-carrying submarine which will run the British blockade and which will bring to New York coal-tar dyes and chemicals, some of which are worth as much as $100 an ounce. The difficulty of obtaining suitable engines has not been considered in these accounts. But the designing of a boat, apart from the provision of adequate motive power, is not hopelessly difficult. Simon Lake, one of the foremost American inventors and builders of submarines, has patented the design here shown. The cargo is stowed away in air-tight and water-

a long cylinder divided into compartments to provide sleeping quarters, a mess room, a navigating cabin, a galley, an engine room and the like. The cylindrical inner hull is air-tight and water-tight.

The cargo is disposed in vertical tanks between the outer and inner hulls. The cargo tanks are air-tight and water-tight and are filled from the top. Air-tight and water-tight closures are provided.

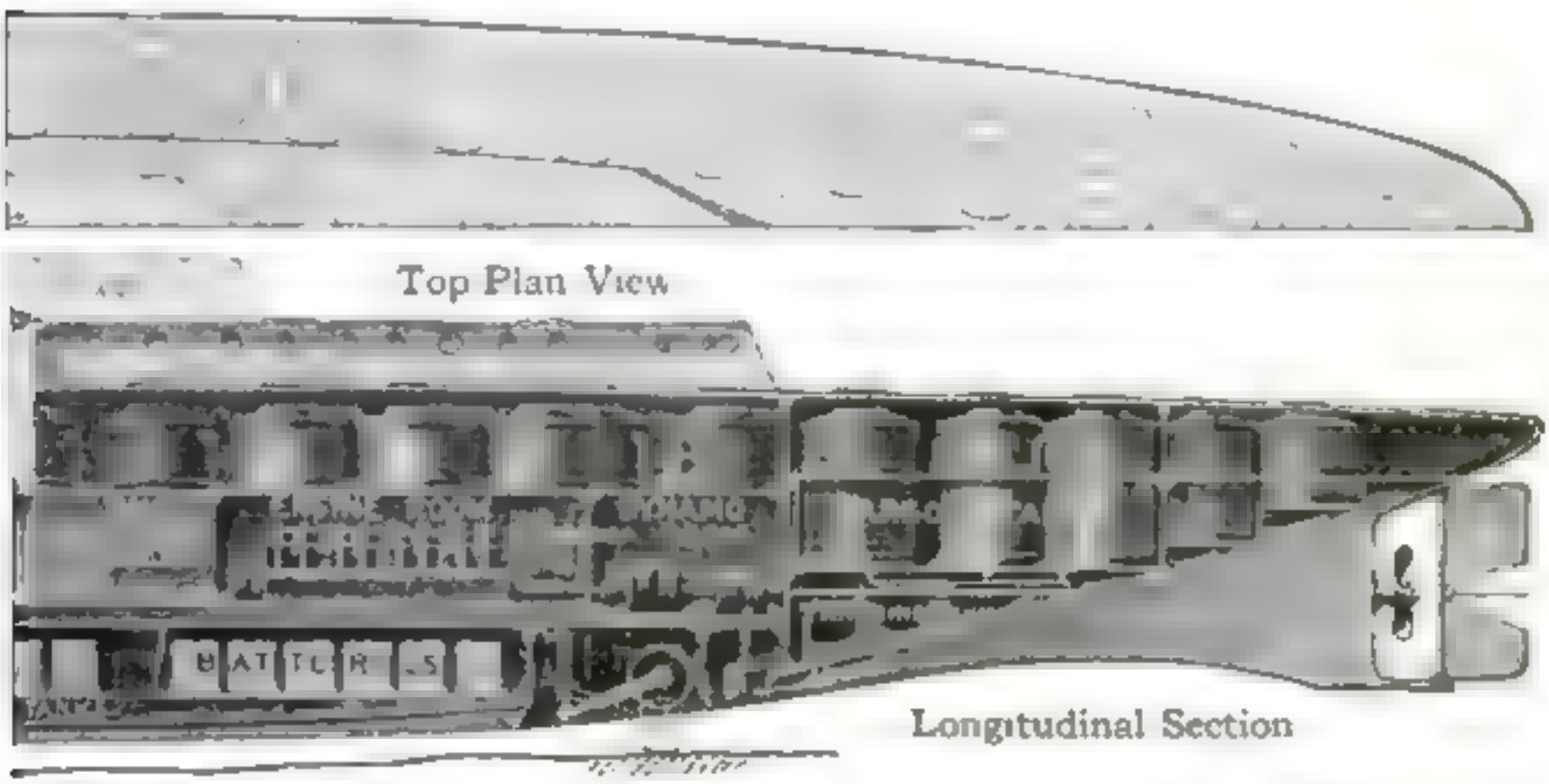
The spaces formed between the outer hull and the inner hull are to be filled with sea water when the vessel is to be are emptied when desired by means of compressed air which is blown from bottles located in the lower part of the hold. As the water is ejected, the space will be replaced by air of such pressure as to equalize the external pressure and thus prevent the collapse of the outer hull. Indeed water is freely used so that the outer non-resisting hull may stand up.

Above the superstructure will be noticed a glass coaming. This is about six feet high and serves to prevent the wash of the waves from obscuring the periscope.

Another feature of the cargo-carrying boat is the provision of wheels which enable the craft to travel on the bed of the ocean, rivers and the like. Mr. Lake was the first to use what may be called "automobile submarines." Indeed his first venture in the submarine field was the *Argonaut*, which ran on the bottom of Chesapeake Bay. The wheels are of great service in following a dredged channel. In some experiments which Mr. Lake performed for the Russian Government at Libau, some years ago, he was able to pick his way out of a harbor much more easily than competitors of his, simply by running along the bottom of a dredged channel.

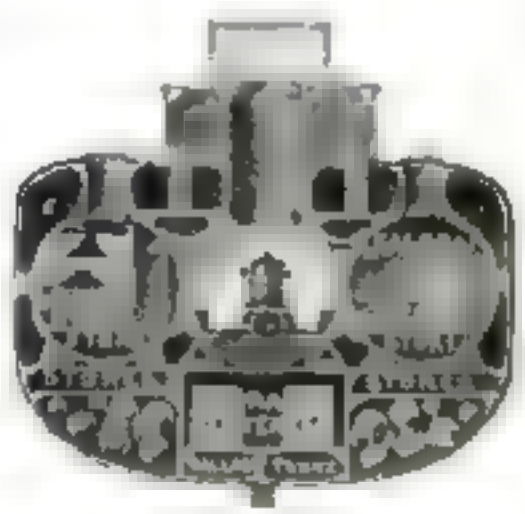
There is no inherent difficulty in building a cargo-carrying submarine, even though it be four hundred feet long. But there is great difficulty in obtaining engines which will drive it.

The practical limit of size as yet attained in big submarine engines, or rather in oil engines suitable for submarine purposes, lies somewhere in the neighborhood of two hundred horse-power per cylinder. The Germans are now building submarine torpedo boats about two hundred and twenty feet long, propelled by twin-screw engines aggregating two thousand, four hundred horse-power and giving a surface speed of seventeen knots. A submarine somewhat bigger, requiring three thousand, six hundred horse-power to develop a surface speed that will enable her to be of any practical use will need three engines with six cylinders each. Now, for a vessel four hundred feet long a very powerful set of propelling machines will be required. Oil engines are out of the question. Steam engines must be employed. And the use of steam engines means the solving of the very difficult problem of insulating the generating apparatus so that the crew will not be parboiled.



Carry $1,000,000 Worth of Chemicals

tight cylindrical tanks. The quarters for the crew, the engine room, etc., are contained in a water-tight cylindrical inner hull. When the vessel is to submerge, the entire space between the inner and outer hulls is flooded with sea water; when the vessel is to travel on the surface, the water is pumped out. The submarine boat has wheels, so that it can travel along the bottom of a dredged channel—a method of propulsion which Mr. Lake has successfully employed. This huge submarine would be about 350 to 400 feet long. It would be not a submarine but a submersible ship



The adaptable stepladder in two of many positions in which it may be placed. On the left, the bracing legs are folded up on a bench and the stepped legs reach to the floor. On the right, the position is exactly reversed, with stepped legs folded up and bracing legs in extended position

A Stepladder with an Ambition to Adapt Itself

THE common or garden variety of stepladder has been in use for so many years that most inventors have forgotten about the possibility of improvements. An Oregonian who had some tasks of varying height to accomplish, hit upon an ingenious idea in adaptable stepladders and secured a patent. In appearance, when folded, the ladder could almost be classed as "pocket variety." It is not much longer than a man's arm, yet when it is unhinged it attains a height of about five feet. The most ingenious feature of its construction is the provision of foreshortened legs. The legs which are fitted with steps are placed upon a stool or a chair of ordinary height. The bracing legs reach to the floor. This performance is reversible: i. e., the bracing legs can be folded up and placed upon a chair with the stepped legs resting on the floor. Also, both sections can be opened, when the ladder becomes an ordinary stepladder. In its extended position it looks fragile and too light to sustain a heavy weight, but it can hold up a live weight of two hundred pounds and more in any one of the several positions in which it may be placed. As a serviceable, portable ladder around the home it meets every requirement.

Pulverized-Coal Burners on Our Modern Steamships

THE combustion of a "spray" of coal-dust blown into the fire-box by a blast of air is very nearly perfect, eliminating smoke, cinders, and firing tools. A high temperature is obtained, actually melting the ash which runs down the walls of the fire-box, and which is easily disposed of. The use of this device, so similar to oil-burners where a jet of oil is blown in the boiler with a stream of air or steam, is past the experimental stage. More heat is obtained from a ton of coal in this way; and rather poor coal can be used. It is probable, if tests succeed, that coal-dust burners may displace oil-burners on many steamships.

Moving Guns with an Electric Battery Crane-Truck

UNCLE SAM may be a bit slow in getting his guns into action, but when it comes to moving them he is right on the job. The photograph shows a two-ton battery crane-truck used at the Naval Gun Factory at Washington for the transportation of guns of all sizes, except the big fellows who are given a moving apparatus of their own. The crane-truck eliminates all danger of fire, and safety and speed are its two best qualities. It can be operated wherever there is room for it to glide about, and it is just as useful on the street as it is indoors.

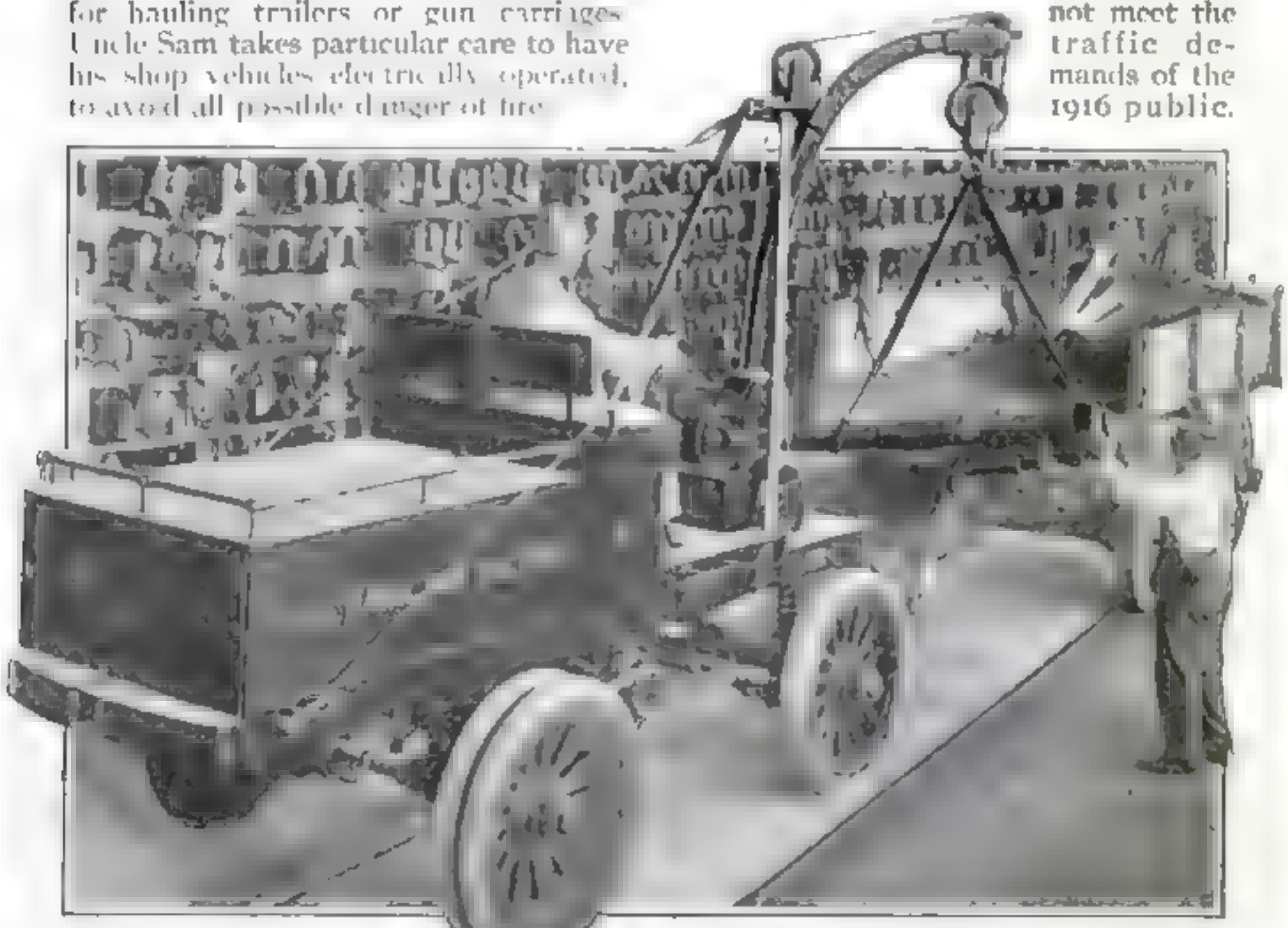
The battery which serves as the propelling power for the truck operates the crane. The driving and crane control handles are within convenient reach of the driver and he operates them simultaneously. When the truck has completed a day's task of lifting and transporting guns it is used as a trackless locomotive for hauling trailers or gun carriages. Uncle Sam takes particular care to have his shop vehicles electrically operated, to avoid all possible danger of fire.

Surviving Horse-Car Lines in the United States

HORSE-CARS still are operated in at least two American cities, New York and Middletown, Ohio. Tiny, low, short, and mounted on a single truck, these cars were built to haul about twenty persons. To-day they often are crowded with two to three times that number and the horses are sorely pressed to draw the load.

When the Middletown horse-car line went into bankruptcy several years ago a junk dealer bought it for four hundred dollars. His profits have been more than three hundred per cent a year, and if he were to pull up his tracks and sell them and his equipment, he could realize many times his original investment.

Recently an order has been given by the public Service Commission of New York that the horse-cars must go. The reason for the demise of these municipal curios is that the picturesque equipment of 1860 can not meet the traffic demands of the 1916 public.



The crane-truck goes from one part of the factory to another, transporting all the guns except the big fellows which need a special apparatus of their own

Why Some Girls Don't Leave Home

Broiling a steak without finger-burning is easy with this grid. Meat juice flows down the sides into a pan, the grid is then reversed and the meat is turned over by pressing a releasing lever at the left side

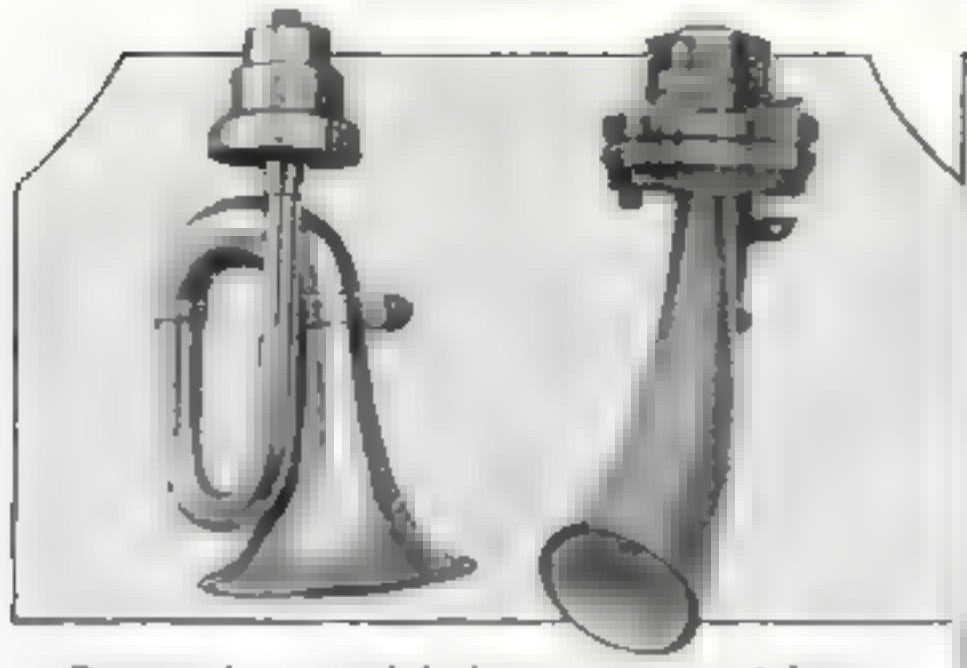
The weight of the beer bottles holds them in the carrying frame

A lamp shade having umbrella ribs. The light can be dimmed by closing the lamp-shade

The small rotating tables which are similar to the "Lazy Betty," can be telescoped into the large dining table

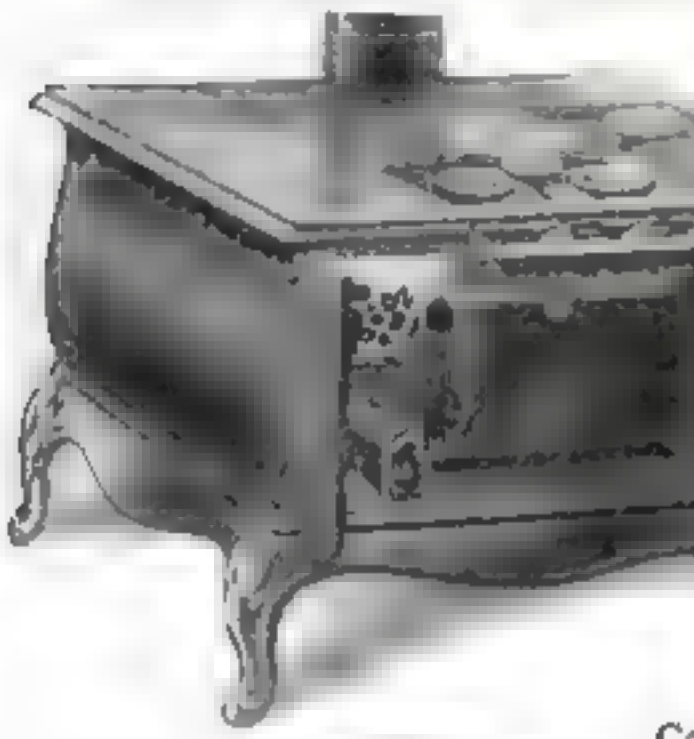
Wine can be kept air-tight with this little bottle pump

From Kitchen Drudge to Household Mechanic

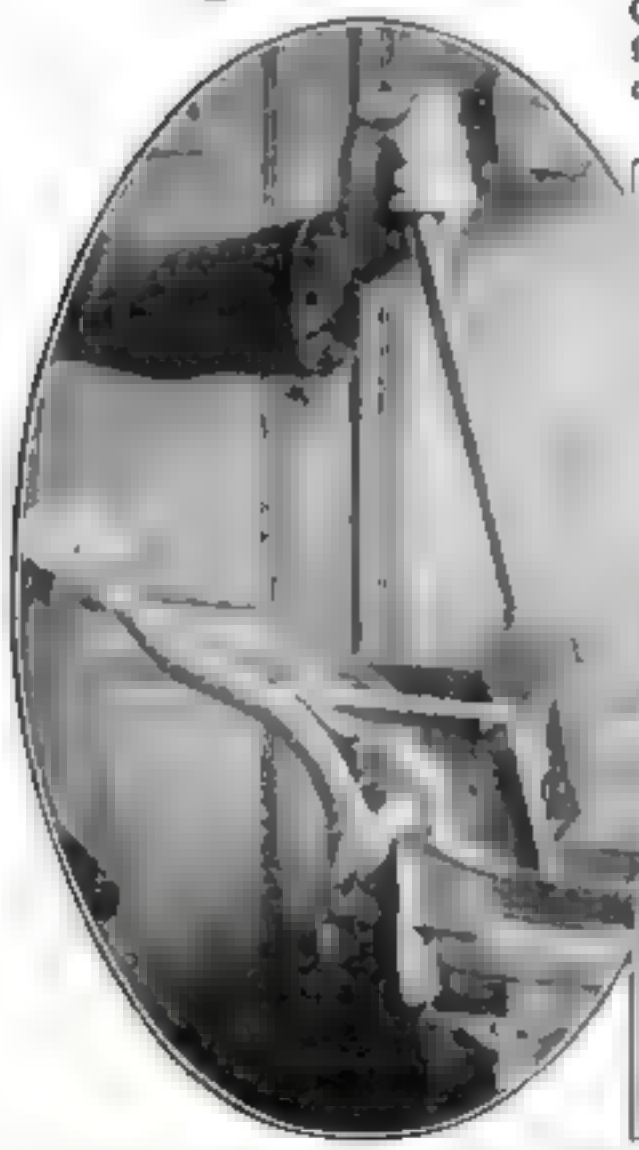


Electrical automobile horns are now taking the place of doorbells. Sound is produced by the vibrations of a delicate membrane

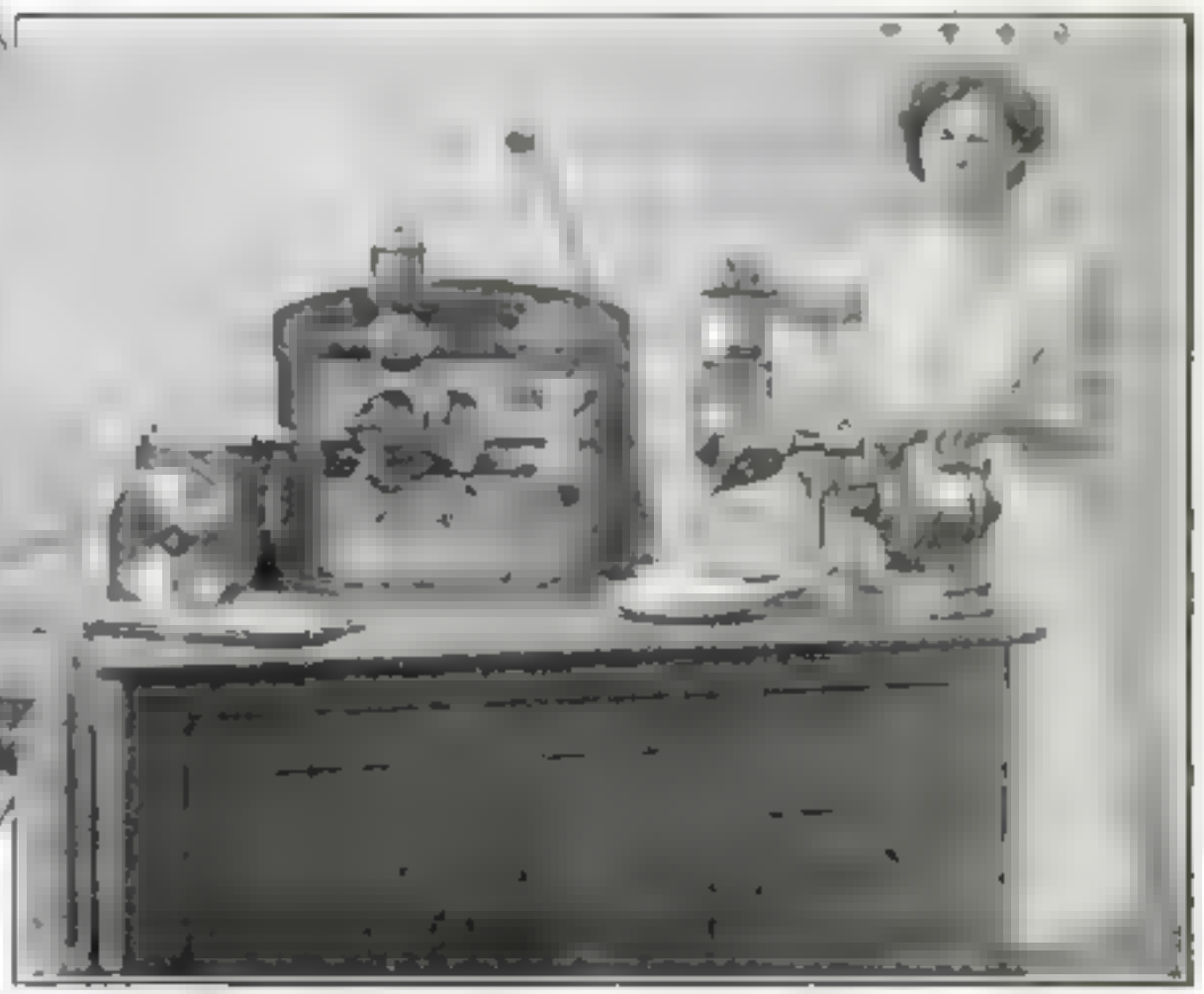
A mop and brush combined. In circle the mop in use is seen. In oval is shown the method of renewing the worn felt. To change the mop to a brush all that is necessary to do is to release the lever



Compactness in the form of a gas and coal range combined



Bones crushed between the rollers make good chicken food



A kitchen utility tool for any number of tasks. It grinds meat and coffee, slices vegetables and freezes cream

This big dump of culm coal is on fire, although there are no visible signs of it. A trench is being cut across the pile to restrict the fire to its present field and prevent it from spreading

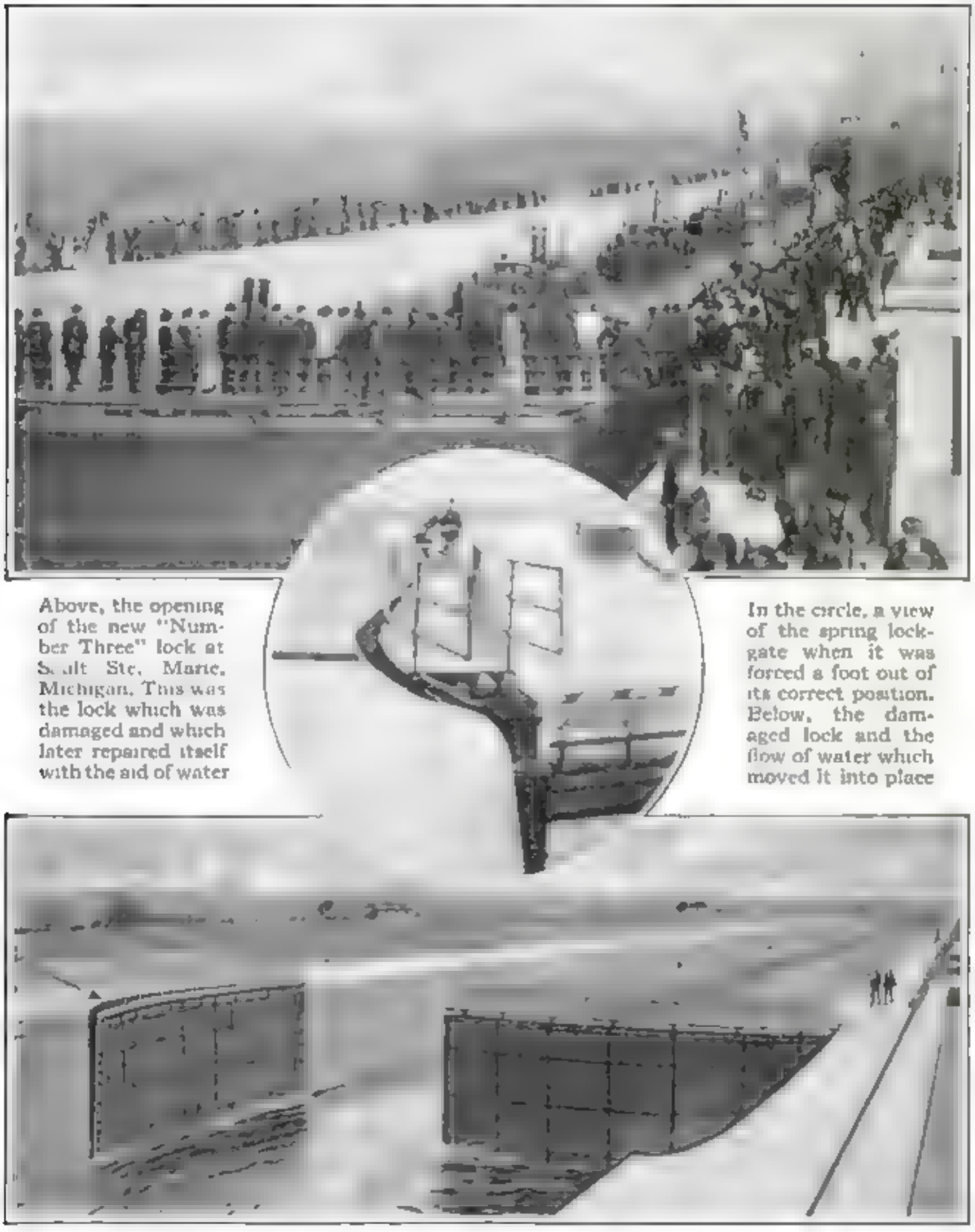
Coal-Dust "Mountains" are Now Repositories of Wealth

IN the anthracite mining region of Pennsylvania there are real ranges of hills, almost mountains, of pure coal. These are the piles of culm or coal-dust screenings, which, under former methods of mining, were thrown out as so much waste. There are millions of tons of this culm, and modern furnaces are now using it. Culm is not only screened and burned as by-coal, a "dust," but is also pressed into briquettes. Modern coal-dust burning locomotives are using it as pulverized fuel. As such it is of permanent value.

The photograph shows a large culm dump near Scranton, Pennsylvania, which has caught afire. Once a fire gains good headway it is extremely difficult to extinguish; it burrows down into the very heart of the pile and then works its way along laterally. A few years ago this culm pile would have been allowed to burn itself out as a worthless property. Now it is being saved, as shown in the picture, by cutting a trench across the pile to check the progress of the fire. Although the photograph gives no visible evidence of a fire, proximity to the radiating heat of the pile would prove to the onlooker that the interior is a veritable inferno.

A Damaged Lock-Gate Repaired by Its Own Water

WATER swirling out of the locks at Sault Ste. Marie damaged one of the gates so badly that the canal engineers despaired; but the trouble was singularly righted by allowing water to rush in again. A ship had passed out of the canal, and the lock was allowed to drain, but one of the gates was closed too soon, was caught in the rushing water, and buffeted so roughly that the top was sprung more than a foot out of plumb. Several unsuccessful attempts were made to repair the sagging gate by means of jacks and turntables. Meanwhile, a long line of ships from the North and South was impatiently gathering,



Above, the opening of the new "Number Three" lock at Sault Ste. Marie, Michigan. This was the lock which was damaged and which later repaired itself with the aid of water

In the circle, a view of the spring lock-gate when it was forced a foot out of its correct position. Below, the damaged lock and the flow of water which moved it into place

some of them with perishable cargos promised on early delivery.

One of the engineers hit upon the ingenious if somewhat hazardous scheme of injecting enough water into the lock to force the gate back into place. Accordingly, the valves were turned on, water flowed in, and the gate was slowly pushed back into its old position.

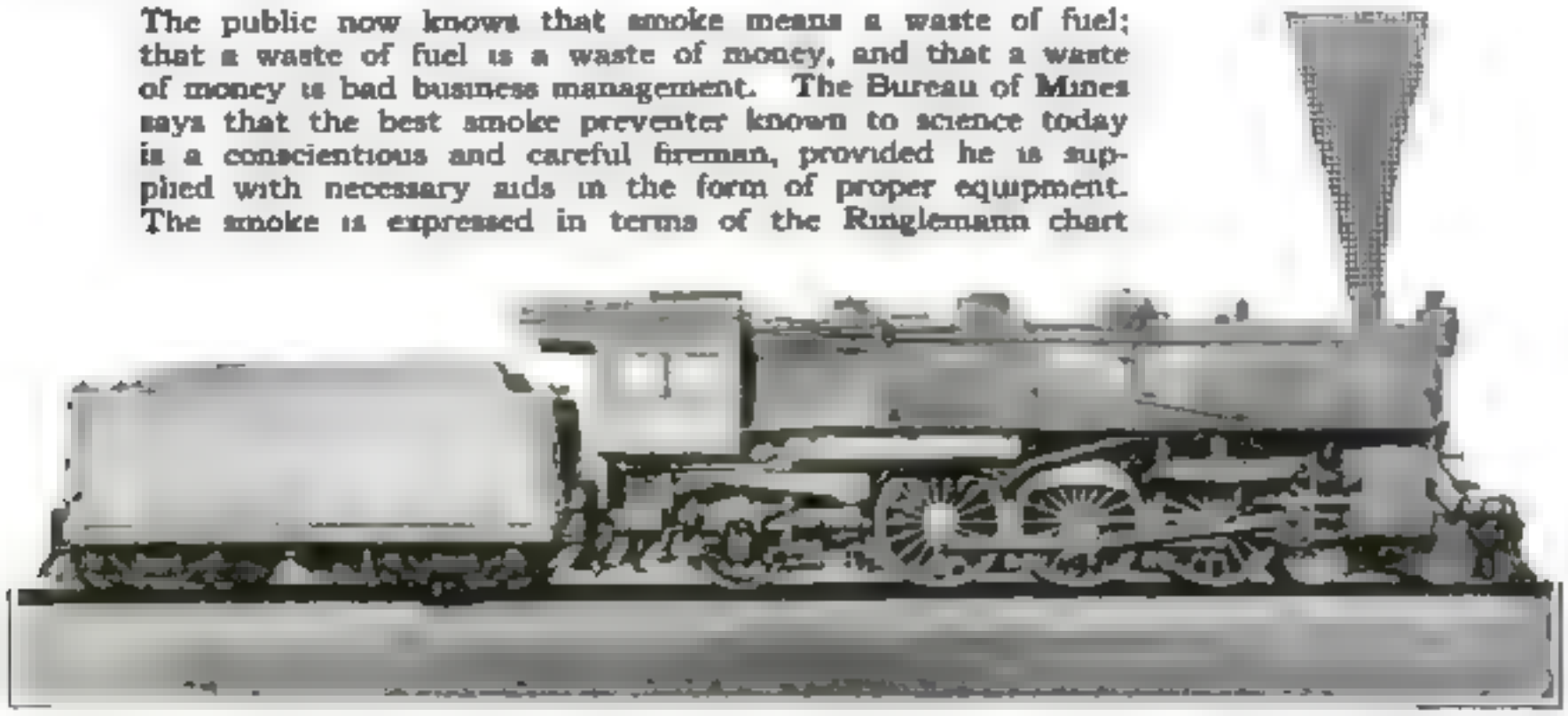
While this makeshift repair was satisfactory for the time being, when navigation closed this fall, the gate was entirely repaired.

This is the new "Number three" lock, which was put in commission about a year ago to cope with the increasing freight and passenger traffic between Lake Superior and the lower lakes.

Taking the Smoke Out of the Smokiest City

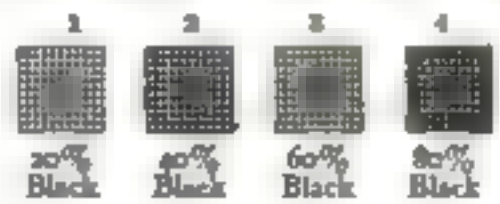
How Pittsburgh Has Solved Its Most Irksome Problem

The public now knows that smoke means a waste of fuel; that a waste of fuel is a waste of money, and that a waste of money is bad business management. The Bureau of Mines says that the best smoke preventer known to science today is a conscientious and careful fireman, provided he is supplied with necessary aids in the form of proper equipment. The smoke is expressed in terms of the Ringlemann chart



TO all intents and purposes, Pittsburgh has solved its smoke problem. Although it is having a hard time living down the time-worn nickname of "the Smoky City," the fact remains that as a result of the efforts of a municipal Bureau of Smoke Regulation, the "production and emission of smoke" in Pittsburgh has been abated fully seventy-five per cent within the past three years. And that in spite of the fact that the business activity and the coal consumption have greatly increased during that time.

No other city has been confronted with a smoke problem of such magnitude or has encountered so many difficulties in solving it. The three rivers, the deep valleys, the frequency of high humidity and low wind velocity, with resultant fogs, were handicaps to be overcome. The extent of the mill district, the great number of stacks in restricted areas, the immense quantity of smoke-producing fuels consumed, the characteristics of the high volatile coal natural to the district and the variety of boiler and metallurgical furnaces, were in part responsible for the dense smoke that used to cover the city like a pall, sometimes making it necessary to use artificial light in midday.



Ringlemann smoke chart with which the density of smoke is estimated

Experts have calculated that smoke causes more than a half billion dollars damage each year to lives and property in the United States. Investigators of the Mellon Institute of Industrial Research, University of Pittsburgh, discovered that Pittsburgh's annual loss, due to the smoke nuisance, was at least ten million dollars. The agitation for smoke abatement crystallized into a great civic movement, in which all the industries of the city were urged to join. On March 4, 1913, the city council passed several ordinances relating to the regulation of production and emission of smoke and enlarging the scope of the Bureau of Smoke Regulation, organized some time before. The smoke limits were changed from eight minutes in one hour for all stacks, to one minute in any period of eight for locomotives and steamboats, and two minutes in any period of fifteen for all stationary stacks.

The Bureau also extended its inspections and watched closely for violations, appealing to the industrial and business concerns to assist as a matter of

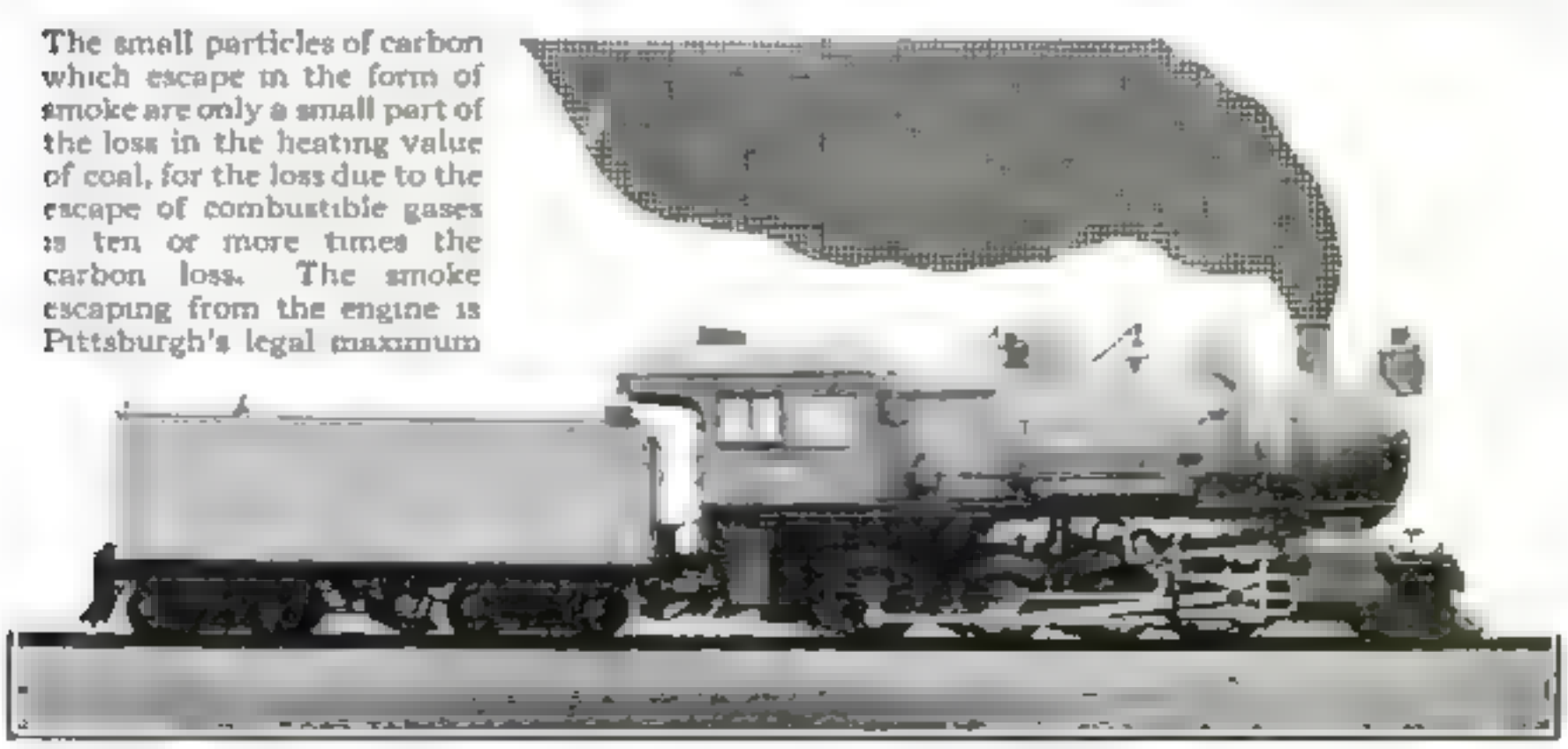
civic pride and for the general good. All of this was done without legal process or application in any way to the courts, although the Bureau was empowered to act against violators. The next year, twenty thousand "cleaning-up" cards were distributed with good effect. They contained the Ringlemann scale for smoke density adopted by the United States Government Bureau of Mines—inch squares checked off in one hundred spaces by light, dark, dense and black lines, representing densities of twenty, forty, sixty and eighty per cent—the third, or sixty per cent, being the legal maximum. The Pittsburgh Chamber of Commerce endorsed the work of the Bureau.

Conferences with railroad operating officials and manufacturers enabled the Bureau to suggest smoke abatement appliances especially fitted for each plant. The widest publicity was given the campaign by local newspapers and there were few stacks in the city that did not have their smoke output closely watched. Improvements had to be licensed by the Bureau, so that only practical appliances were permitted. Hundreds of concerns subsequently reported to the Bureau that the smoke abatement crusade had benefited them by helping to reduce their coal consumption and lessening operating costs.

The beneficial results of the smoke abatement propaganda have been widespread. Fully ninety-nine per cent of the locomotives in Pittsburgh yards are now complying with the law, the number involved being eleven hundred and ninety daily. Before the campaign, only one per cent complied with the law.

Even to strangers in the city, the smoke abatement is very noticeable in Pittsburgh. The atmosphere is practically free from soot particles in the downtown section in particular. Fogs are disspelled by the middle of the day and frequently by the middle of the morning, whereas formerly the city was in a pall for at least a day, and sometimes longer. The Pittsburgh Weather Bureau local office announced that the periods of "dense smoke" last year were less than one half those of 1913, despite the fact that at least two and a half times as much coal was consumed. The Bureau of Smoke Regulation has calculated that the annual saving to the people of Pittsburgh, through the reduction in the quantity of smoke cannot be estimated at less than two million five hundred thousand dollars.

The proper way to read smoke densities from the Ringlemann chart is as follows: The chart is placed in line with the top of a stack a sufficient distance from the eyes so that the lines are not visible (about ten feet) and the smoke emitting from the stack is then compared with the different scales on the chart. This enables every factory manager and fireman to be his own smoke inspector and determine at all times if the smoke ordinance is being violated. In Cincinnati any smoke of greater density than the sixty per cent scale violates the ordinance.



The small particles of carbon which escape in the form of smoke are only a small part of the loss in the heating value of coal, for the loss due to the escape of combustible gases is ten or more times the carbon loss. The smoke escaping from the engine is Pittsburgh's legal maximum

Eradication of Weeds Will Prevent Hay-Fever

AN authority on the subject states that from the standpoint of the number of patients affected hay-fever ranks among the first of the non-fatal diseases. According to him goldenrod is only responsible for a small percentage of cases, but the common ragweed, with its insignificant green flowers, is directly responsible for a majority of cases.

Besides the ragweed, of which two main varieties, the wormwood and the giant, are the most important, there are ten other plants indigenous to the Southern States, the pollens of which produce hay-fever. They all have the same characteristics: they are wind-pollinated; very numerous; the flowers are inconspicuous, with no bright color or scent because insects are not to be attracted, and the pollen is formed in great quantities. The development, duration, and conclusion of hay-fever are synchronous with the pollinating period of the ragweeds, and any elevation under six thousand feet may produce the weeds and the disease to susceptible persons. It would appear that there is a wide difference in the degree of susceptibility of different individuals to the pollen. An attack would develop, therefore, only when the exposure overcomes the resistance of the subject and only to this extent

It has been asserted that the pollen, under the influence of the nasal secretion, germinates and sends out its germ tubes, thus producing the irritation. This germination takes place only in the presence of sugar, which is absent in the nasal secretion, and is inhibited by sodium chloride, which is present. The process of germination usually takes about two hours, while the local reaction of hay-fever may take place in a few minutes. The majority of hay-fever patients present no unusual abnormal intransal condition except during the attack, and operations for nasal obstruction, unless indicated for other reasons, have been seldom successful in their intended results, and are rarely advisable. Any of the various treatments for hay-fever have not met with conspicuous success, and the sure means will be in the eradication of the weeds causing the disease.

Protecting Jewelry Store Windows With a Burglar-Proof Curtain

THE thief, brick in hand, awaits his opportunity. When the policeman on beat passes out of sight he slinks down the quiet avenue and takes up a position in front of a jewelry store with an expensive and elaborate window display. Reposing in the right-hand corner of the window is a tray of diamonds. This the thief decides to steal.

Choosing a section of the window where the glass will make the least noise in falling, the thief draws back his right arm and the brick crashes through the window. With lightning agility he thrusts his hand through the broken pane, and then, startled and utterly dismayed, as quickly withdraws it. Had he not done so a burglar-curtain of steel, released from the top of the window at the instant of contact of brick with glass, would have severed his arm at the wrist.

In other words, he was thwarted in his attempt to steal by a burglar-curtain designed to drop and cover the window the instant the glass is broken. In making his superficial examination he had failed to detect the minute strands or wires stretched across the window, several of which were severed when the glass was broken, setting into action a mechanism which released the curtain.

The wires, stretched tight and anchored at their lower end to a rigid frame and at their upper end to a latch, are arranged close enough so that an object thrown through the pane will sever one or more of them. When this occurs the latch is drawn downward, permitting the retaining rods to move in under forced pressure of their tension springs, which releases a ratchet engaging with a shaft round which the curtain is wound. The curtain falls due to gravity.

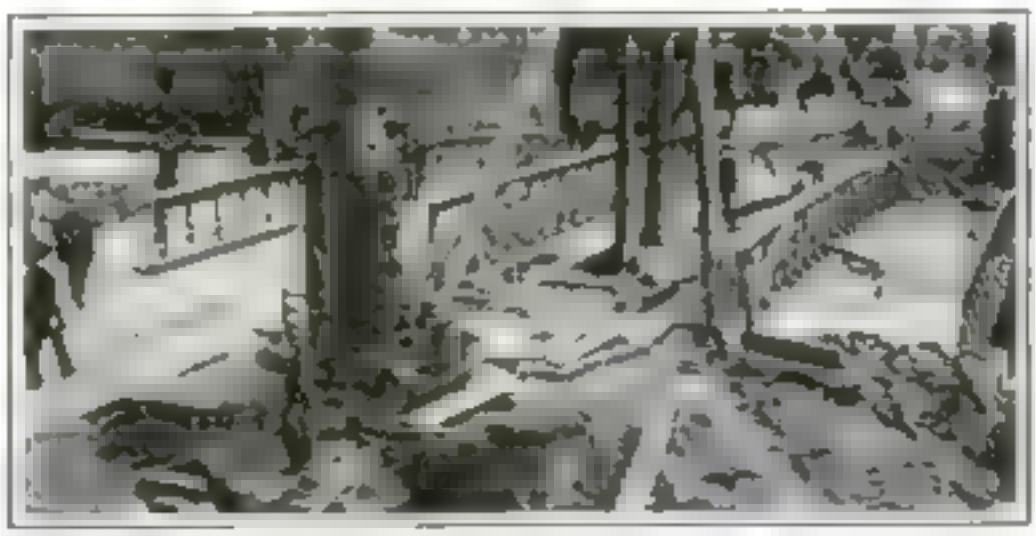
The device has been patented by Max Richter of Chicago, but he does not specify any particular kind of curtain, although he suggests that steel would be the most effective. A simple safety appliance prevents the curtain from accidently falling when the window is being cleaned. It is wound up on the shaft in a "set" position by means of a sprocket wheel.

The Burglar-Proof Store-Window

Let the burglar break the glass and at once a curtain of steel is released from the top of the window. It drops of its own weight the instant the glass is broken and one or more of the wires in back of the window are severed. The curtain is prevented from falling when the window is being cleaned by a simple safety appliance. A sprocket wheel winds up the curtain in a "set" position on the shaft. The breaking of one wire will drop the curtain

Lowering a Bridge Without Blocking the Street Traffic

THE task of lowering a bridge spanning the canal in Cincinnati without seriously blocking the enormous amount of traffic over the span, has presented an interesting task for the engineers in charge. A large number of car lines use the bridge, and there is much vehicle and foot traffic. To overcome this difficulty the bridge has been cut in two parts and while one half is being lowered and put in condition for use, the other portion remains with cars passing over it. Thus the traffic is only partially inconvenienced. This picture shows the elaborate mechanical equipment used in the work.



The bridge was cut in two parts and while one half was being repaired the other half was being used by cars

A Giant Grinder Which Goes to Its Work

IF you have an axe to grind, it is no longer necessary to bring the axe to the grinding wheel, for a portable grinding wheel of full-sized proportions has been brought into the grinding field. Numerous small grinding equipments intended for light work have been introduced from time to time, but only recently has a man-sized portable grinder been a reality. A huge motor mounted on a three-wheeled truck supplies the driving energy to the abrasive wheel through flexible tubing. In operation, when the speed has been adjusted to suit the needs of the workman, he grasps the handles of the wheel on either side and brings it against the object to be ground at any angle or any pressure desired. Grinders of this type are intended for use in foundries or in factories where there is a great deal of heavy abrasive work to be done.

The grinder is a portable, man-sized one for heavy abrasive work in shops and factories

How to Get Thin and Fool the Family While Doing It

EFFORTS at reduction at home are usually futile, because of the want of sympathy offered by the family, the difficulty in securing proper individual diet, the temptation provided by the daily sight of all kinds of food, and the urging of members of the family to be less strict than the physician directs.

Reduction treatment is easiest and vastly more successful in an institution or at a health resort, where definite diet can be prescribed and furnished, and where, in an atmosphere of routine and obedience, there is less temptation to transgress. There is every encouragement to persevere through the community of interest felt by every one and the force of numerous good examples of obedience daily before one's eyes.

Unless a settled determination and a conscientious effort exist in the mind, there is no use of attempting reduction of corpulence. Indulgence in alcoholic beverages, course dinners, extra suppers after theater, etc., defeat all measures that may be taken. These difficulties are oftenest encountered in people between the ages of thirty and forty.

Why a Grasshopper Is Like a Telephone Lineman

EVERY boy and girl has seen a telephone or telegraph lineman climb a pole by means of iron spurs strapped to his shoes. The grasshopper's legs carry spurs which act on a similar principle, although the method is different. The grasshopper has neither the weight nor the strength to drive its spurs into the substance of the object or other surface on which it is climbing. But a twig or a grass blade under a microscope appears, as do the poles to the unaided eye, to be studded with holes and superficial rough places. The grasshopper's sharp spurs catch into some of these holes and uneven spots and thus enable it to climb.

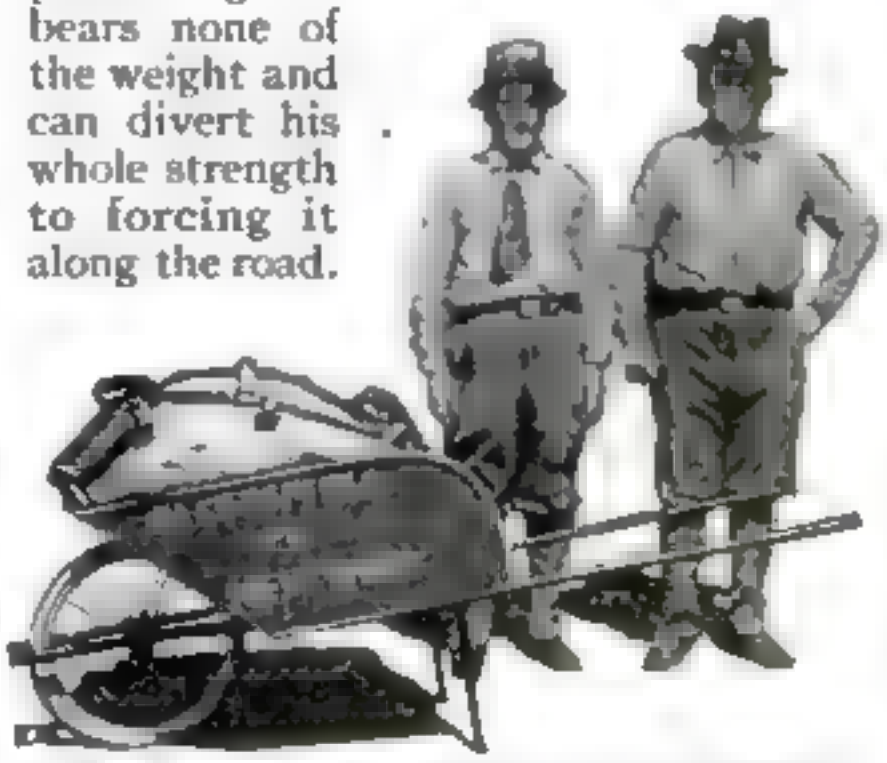
A grasshopper's leg, showing the sharp spurs which enable it to climb and which prevent it from slipping when jumping

By the aid of a small reading glass one can carefully watch grasshoppers in the act of climbing and discover that their method is much like that of the telephone man, with the exception already noted. Instead of making holes, they take advantage of holes already made. But they have still more frequent and serviceable use. This is to prevent the insect from slipping back when it makes its gigantic effort in jumping. Every one knows that it would be difficult to stand still on smooth ice and make a long jump forward. A rough surface facilitates the movement. The grasshopper is a more successful jumper than any boy can be, because it can leap many times its own length. It must therefore obtain a firm hold on the ground so as to prevent the loss of force by backward slipping. All its energy must be exerted in throwing its body forward. If a boy could jump like a grasshopper, comparing size with size, he could hurl himself forward at least four hundred feet. A grasshopper an inch in length finds it easy to jump a hundred times its length.

Hitting the Trail with a Wheel-Barrow and Determination

TRAMPING across the continent with the aid of all sorts of odd contrivances seems to be a favorite form of diversion for the athletically fit. The last team to "hit the trail" for New York are two Bakersfield, California, mechanics, who are pushing their camp outfit ahead of them in a wheel-barrow. They intend to traverse the length of the Lincoln Highway and expect to reach the end of their journey before the winter season makes camping too uncomfortable.

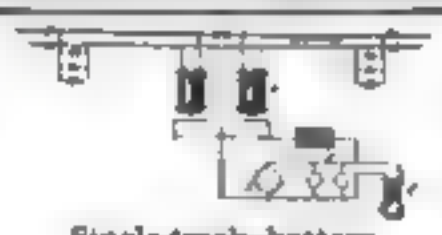
Their outfit weighs about one hundred pounds and includes a tent and necessities for road travel and life in the open. The whole load is packed on a specially constructed wheel-barrow which balances as perfectly as a pair of scales. It has a capacious sheet-metal body with handles about twice as long as those of the ordinary wheel-barrow. The handles are equipped with rubber grips. The wheel is of the bicycle type and it is set well back under the body. The vehicle is so arranged that the man pushing it bears none of the weight and can divert his whole strength to forcing it along the road.



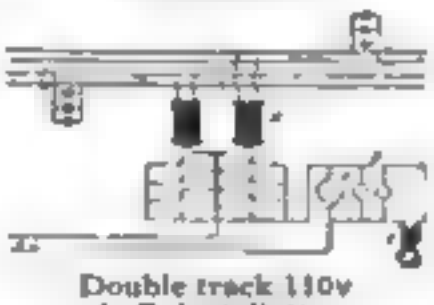
The determination is in the men, everything else is in the featherweight wheel-barrow

Automatic Flagmen to Warn Motor-Car Drivers

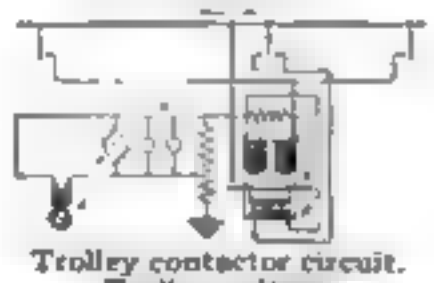
The automatic flagman at a crossing. At right, detail of four different installations



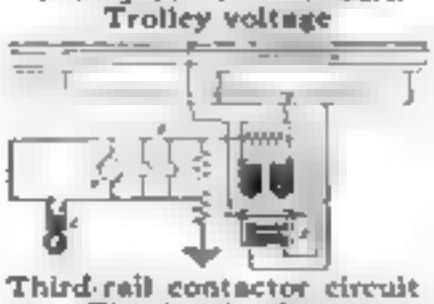
Single track battery installation



Double track 110v A. C. installation



Trolley contactor circuit. Trolley voltage



Third-rail contactor circuit Third-rail voltage

IN these days of automobiles and motor-cycles, something more than the old-fashioned "Stop, look and listen" sign is necessary at railroad crossings. Such signs are entirely too unobtrusive to attract the attention of a motor-car driver going at sixty miles an hour. At night they are practically worthless.

A striking experiment has resulted in the invention of the "automatic flagman." At the approach of a train it rings a loud gong, and waves a bright red disk by day and a red lamp by night. So sensitive is the human eye to red and to motion that such a warning can hardly escape notice.

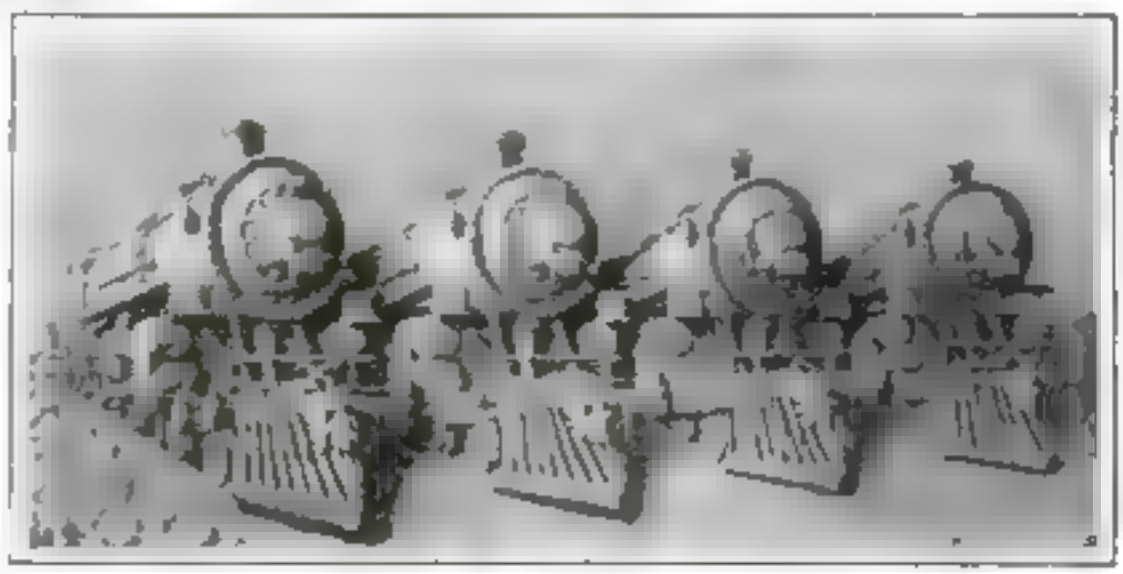
The device consists of a weather-proof case containing the operating mechanism and a signal disk upon which are mounted standard ruby-red switch lances with an incandescent lamp between. Energy is supplied by a small electric motor, which operates the mechanism that rings the gong and waves the disk.

The motor receives its energy from storage batteries, lighting circuits or trolley circuits, depending on the character of the installation. On steam roads the track is insulated and bonded for the desired distance away from the signal and is charged with current from a small battery. On entering this block the train completes the circuit and operates a relay, which connects the motor with the power circuit.

A Western Railroad's Clay Locomotives

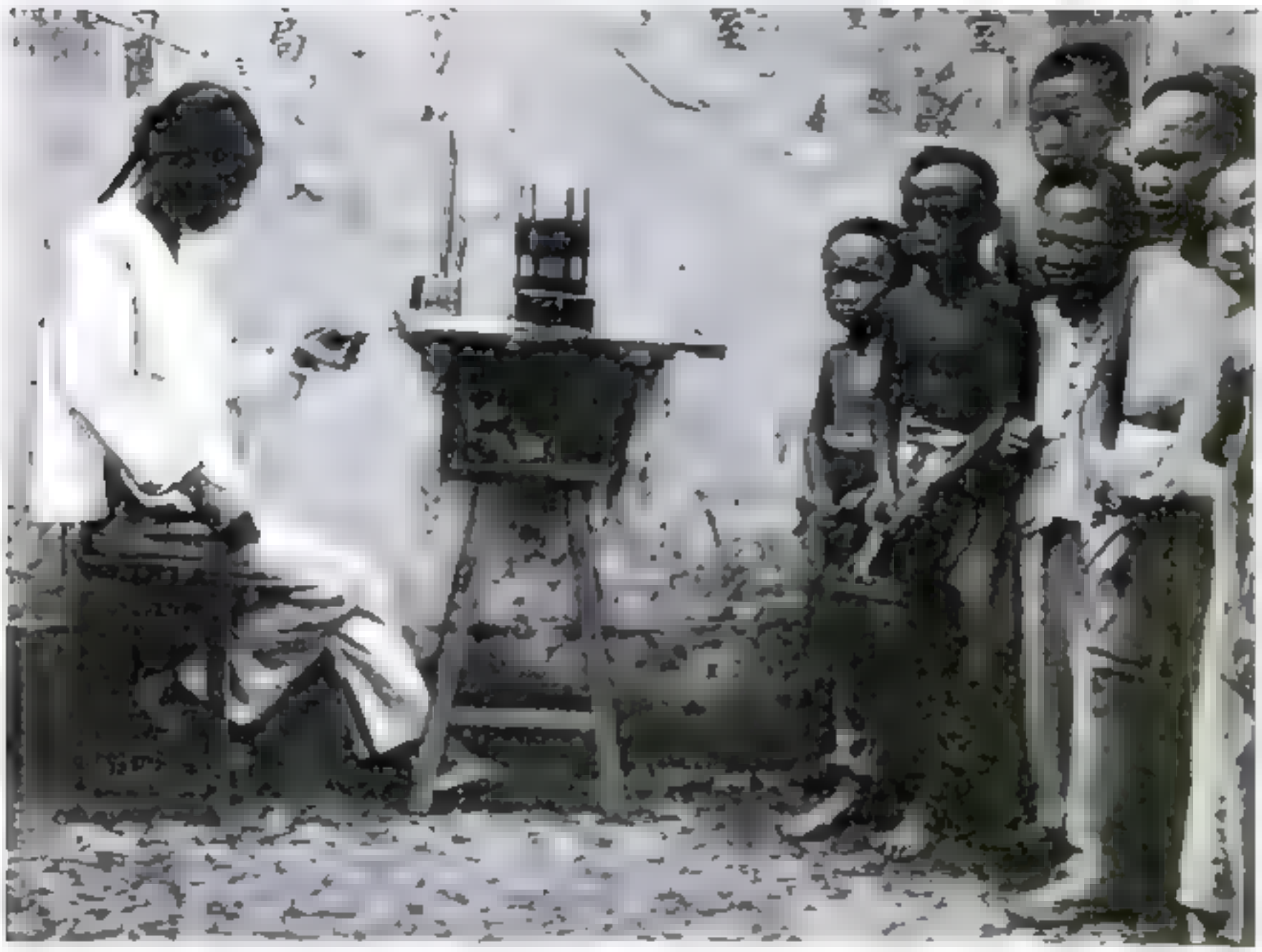
WHEN a western railroad wanted to convey the information to the traveling public that its locomotives were of the newest and biggest design it called in Emory P. Seidel, the sculptor, and asked him to make models of them. Mr. Seidel searched some time for a suitable substance out of which to construct his models and finally decided upon a greasy composition from Italy which closely resembles clay. The models are five feet in height and represent three weeks' work on the part of the sculptor. The cost was five hundred dollars.

It took a sculptor three weeks to fashion these locomotives in a clay composition



Chinese Doctors and Their Ways

By Franz Otto Koch



A Chinese street doctor examining hair from several youthful callers. The physician diagnoses a disease from a patient's hair and then proceeds to drive his needles

THE native Chinese doctor is a curiosity. He passes no examination; he requires no qualifications; he may have failed in business and set up as a physician. In his new profession he requires little stock in trade, medical instruments being almost unknown.

Acupuncture, as it is called, is one of the nine branches recognized in medical science among the Chinese; it is of most ancient origin, having been in use from time immemorial. There are three hundred and thirty-seven body markings to be learned; every square inch on the human surface has its own name, and some relationship to the internal parts, purely imaginary, is assigned to it. The user is cautioned against wounding the arteries; hence he must know the position of the blood vessels. By close study of a manikin pierced with holes, the Chinese physician learns where to drive his needles. Parts of the body are selected, which may be pierced without fatal results. Sometimes heat is applied to the outer end of the needle and this is called hot acupuncture, but the needle is never heated before insertion. In some cases the needle has been known to break in the body of the patient and has had to remain there until extracted by some skillful Western practitioner.

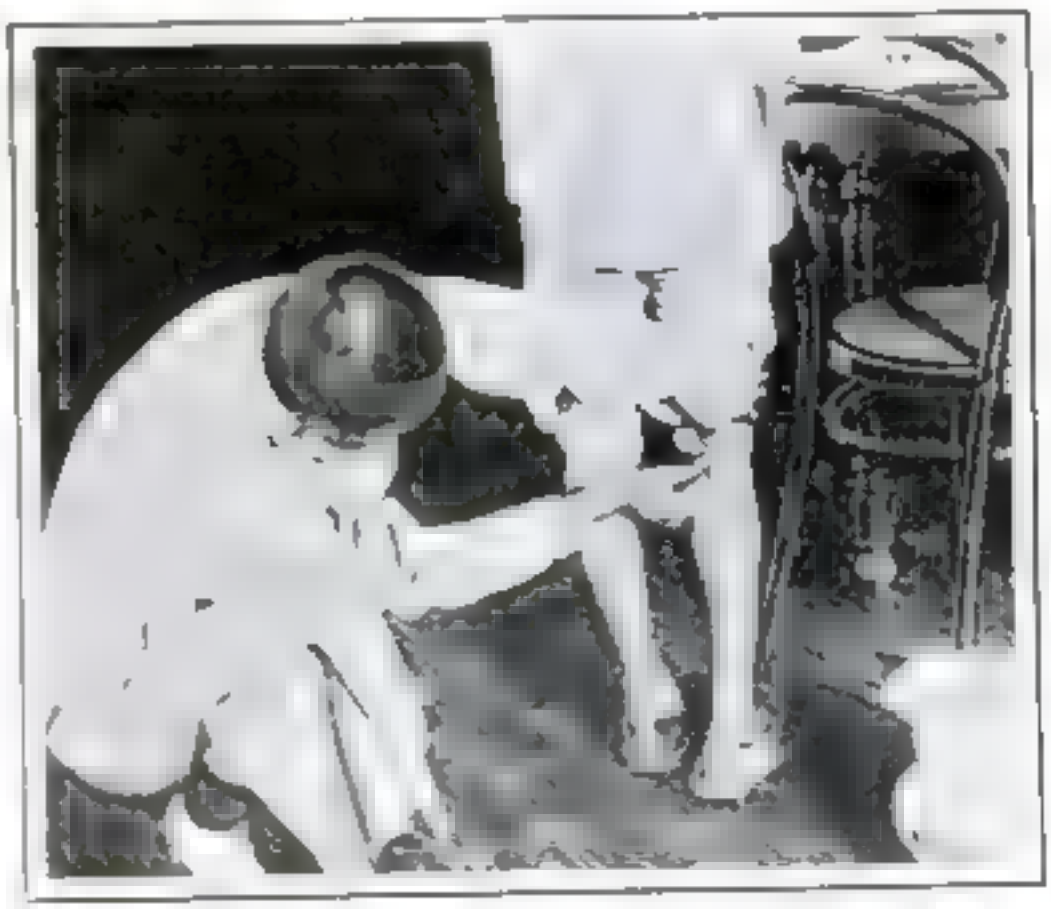
The needle used looks very much like a sewing-machine needle, but it is longer and coarser. Some of the Chinese doctors have needles two feet long, and are supposed, by ardent admirers, to be able to drive these instruments entirely through the patient's body. The great size of the needles is in reality intended to represent the greatness of the owner's skill and reputation. The needles used

whose father has been a doctor before him. Confidence in him knows no bounds should his grandfather have followed the same calling. This is not a mere fatuous belief in heredity, but is based on the supposed value of old prescription books passed on from grandfather to grandson.

At left, the attractive and decorative office of a prosperous Chinese physician in Peking. Below, drying medicinal herbs in a Shanghai courtyard. These are later made into medicine

are of eight forms, as follows the arrow-head, blunt puncturing, spear-pointed, fusiform, round, capillary, long and thick. The point of insertion, the depth and the direction are all-important. The method is usually to drive the needle through the distended skin by a blow from a light mallet

If he can get an old book of prescriptions from a retiring practitioner, so much the better for the Chinese doctor. He is now equipped to kill or cure, as chance or his ignorance may dictate. The doctor most entitled to confidence in the sight of his countrymen is the man



Acupuncture. The skin is punctured with a needle until in some spots it has as many holes as a sieve

Fees vary according to the physician's social class and that of his patients, and also according to the physician's place of residence. The enormous sum of perhaps fifteen American cents or half a dollar at the most may be charged for a visit, if the doctor comes in his sedan chair. Of this amount, a large proportion goes for the chair. Should the doctor belong to the humbler ranks and come on foot, his fee is proportionately less. He assumes a solemn air and an owl-like look as he peers out of the semi-darkness

A choice assortment of medicinal roots soaking in a Chinese drug shop prior to their conversion into drugs

A Peking street dentist ready to do business The monkey is his trade sign

The Chief instruments of a Chinese doctor, including a pair of scissors, a large knife and a straw hat which signifies prosperity

Doctoring the nose with a few drops of herb medicine on the end of a needle. Sometimes the needle is driven with a mallet

of a Chinese bedroom through great goggle-shaped glasses—two inches across and set in huge uncouth copper frames.

Most important in diagnosing a case, according to Chinese ideas, is the feeling of the different pulses of the human system. The pulse at each wrist is felt, and each is divided into three, which according to the light or heavy character of the pressure, indicates a different organ of the body. By thus feeling the pulses, the states of a dozen real or imaginary organs are determined. Having then learned by the pressure of these three at each pulse, the seat of the disease, a few questions may be asked, but these are considered scarcely necessary. A prescription, sometimes calling for the most horrible and nauseating compounds, is prepared in large doses; for the native believes that the larger the dose, the more likely is it to prove efficacious. In prescribing for natives, the foreign doctors have to give the strictest injunctions that the paper box in which the pills are contained is not to be swallowed.

Among Chinese medicines, besides some that are to be found in our Western *Materia Medica*, are snake skins, fossils, rhinoceros or hartshorn shavings, silk-worms, asbestos, moths, oyster shells, and other things. Almost anything disgusting is considered a good medicine. Apothecaries' shops abound where prescriptions are made up.

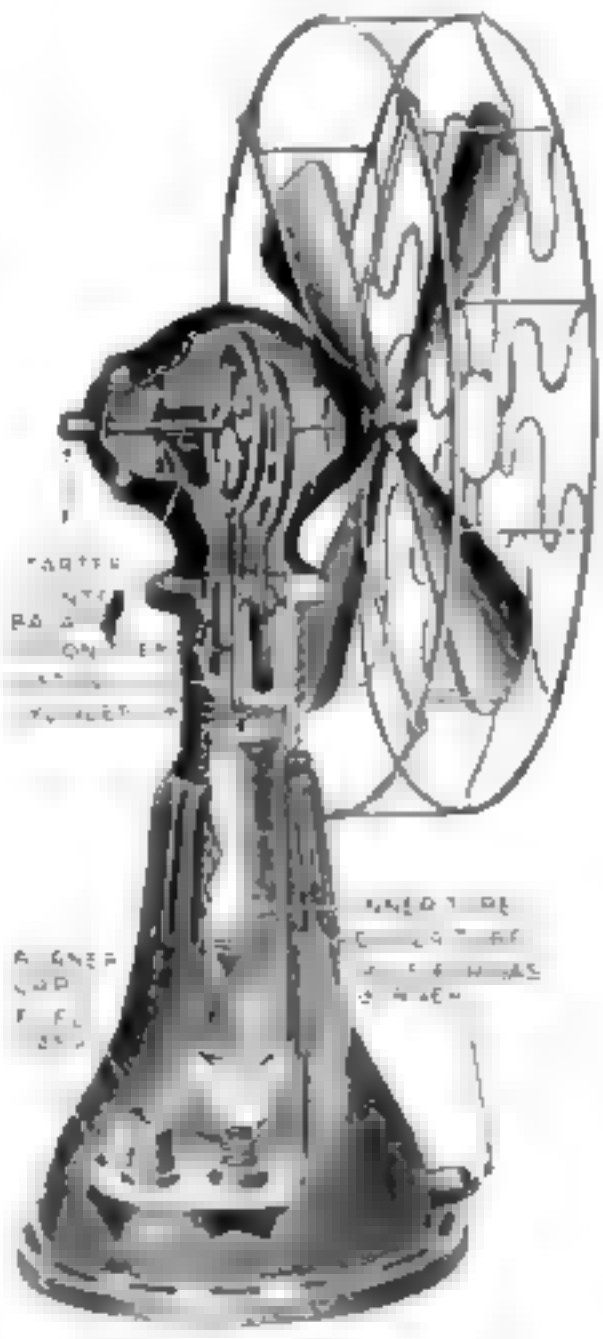
The manner in which the Chinese treat their physicians is characteristic. Should a speedy cure not result from the doctor's treatment, the patient calls in another. If he does not improve, he calls in a third. Thus the medical skill of the whole neighborhood may be drawn upon.

Keeping Cool with a Fan Driven by a Hot-Air Engine

SUMMER and electric fans go well together, but where electricity is not to be had people have had to forego such pleasures. They will not be obliged to go without their summer breezes any more, however, for the little fan illustrated can be used any place where a connection can be made to gas or where alcohol can be purchased.

The fan is operated by a small hot-air engine in which all the rotating parts are carefully adjusted and balanced so that it runs smoothly and evenly, driving the blades at a speed sufficient to send forth a breeze that will lower the temperature on the hottest day.

The operation of the fan is interesting. The air in the lower end of the cylinder is heated by the lamp and expanding drives the piston upward, revolving the fan and creating a momentum. This cycle of operations continues, the fan gaining in speed with each revolution, and continuing to run as long as the fuel holds out. When gas is not to be had, denatured alcohol will serve as the fuel. In many cases the cost of operation is not more than one half cent an hour, and the fuel tank will hold sufficient fuel for twenty-four hours' running.



The fan is run by gas or denatured alcohol. It costs about one half cent an hour to operate it

The Latest in Golf Clubs

A PHILADELPHIAN has invented a "combination" golf club. A ratchet in the heel of the club makes the various angles possible. Give the ratchet a twist and you convert the club from a driver into a mid-iron, mashie, putter or niblick. The change is made in remarkably quick time, and it can be changed from a right- to a left-handed club without effort.

A New Safety Razor with a Lamp Attachment

AN Englishman, weary of bloodshed, has bethought him of a means of enlightening the gloomy and otherwise dangerous ritual of the shave. He has invented a miniature electric lamp provided with an adjustable clip and flexible cord which may be attached to the razor and light the path of the blade through the tough bristles of the human face.

With his lamp attachment one may plunge fearlessly into the blackest depths of a three days' growth of beard and emerge from the ordeal unscathed. The lamp is attached to a conventional type of razor by a simple clip. It travels with the blade or with the motion of the hand. By looking into the mirror the man shaving himself can determine just what progress he is making and whether or not he is going to come through the operation with his two ears intact.

A miniature electric lamp is attached to the handle of the safety razor and helps to illuminate the gentle art of shaving

The lamp clip can be attached to any one of the many makes of safety razors. The inventor is now busy on another lamp attachment for the old type of razor.

How the Government Would Make Paper from New Woods

THAT satisfactory wood pulp can be made from a number of heretofore little known woods is evidenced by a government publication just issued, which contains seventy samples of paper manufactured by different processes, chiefly from woods practically unused for this purpose up to the present time.

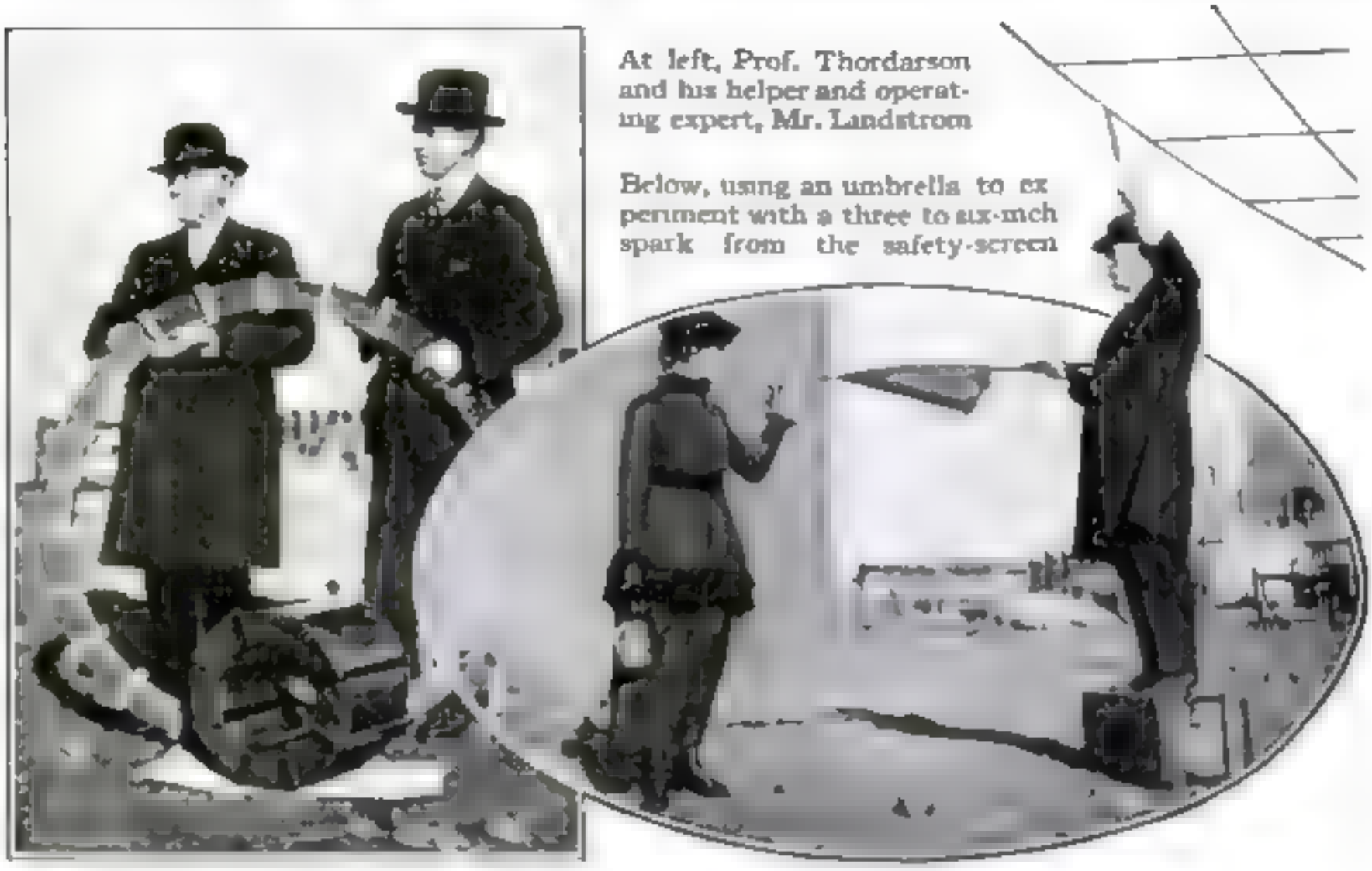
What Makes the Hair Suddenly Turn Gray?

A PHENOMENON that has always aroused curiosity is the sudden turning gray of the hair under the influence of great emotion. Several historical instances are open to doubt, such as the case of Marie Antoinette, who is said to have become gray in the night before her execution, but there are several well authenticated cases vouched for by medical observers. One of these refers to a young soldier in the present war.

He was in a trench in the Argonne district which was blown up by a mine. He was projected into the air and then fell beneath a pile of debris. When he was extricated he was found to be deaf, and a few days later in an English hospital he noticed to his great surprise that there were tufts of white hair on the left side of his head. The loss of color was complete from the roots to the ends of the hairs and the longest hairs were just as white as the shortest. There was not a brown hair amidst them. The gray hairs were solidly implanted and could be pulled out only by considerable force.

Subsequent investigation brought out the fact that the patient's left side of the head and face was most injured by the explosion and the fall of earth. He also suffered from an incessant twitching of the left eyelid. As his hair was whitened solely on the left side the physicians came to the conclusion that the injuries sustained were directly responsible, but they arrived at no definite conclusion. In fact, science has yet to find a cause for the sudden turning gray of the hair.

Toying with High Tension Currents



At left, Prof. Thordarson and his helper and operating expert, Mr. Landstrom

Below, using an umbrella to experiment with a three to six-inch spark from the safety-screen

ELECTRICAL science has brought forth so many startling discoveries in the last decade or two that even the average person is rather proof against being astonished at anything. Almost incredible accomplishments of an inventor's years of unremitting labors are often dismissed with the faint praise that electricity is only in its infancy. Like almost all other things, however, there are exhibitions of electric force that tickle the public fancy without conveying any idea of commercial worth. A good example of this is seen in the theatrical displays with high-frequency currents, the beholders little realizing that they are interesting applications of the same power employed in wireless telegraph transmission.

A remarkable electrical construction which has excited great interest in both the curious spectator and the far-seeing engineer is the 1,000 kilowatt, 1,000,000-volt, 60-cycle transformer, constructed by the well-known electrical instrument maker, Mr. C. H. Thordarson of Chicago. Requiring two years' time in construction, costing $36,000 and entailing no end of thought and ingenuity, it was primarily made to demonstrate certain theories on transformer construction and to investigate the behavior of electric conductors when charged with extremely high voltages.

Electric currents, when traveling at very high frequency, pass almost entirely upon the surface of the conductor. The resistance of such a circuit is therefore so high that unless a high voltage is operating no current at all will flow. Such conditions are met in stage apparatus. Ordinarily the operator can handle the conductors with impunity, the current merely passing through his outer skin or perhaps entirely in his clothing. The alternations may readily be a million per second or half [that number of "cycles" per second. In the case of ordinary electric light and power circuits the most common frequency is 60 cycles per second, some, however, being as low as 25. In such cases the current flows quite like the direct sort, uniformly through the section of the conductor, whether it be wire or person, and a voltage as low as 1,000 is likely to be fatal. It is realized, therefore, that in the new Thordarson apparatus there is found for the first time the combination of the high voltage with ordinary

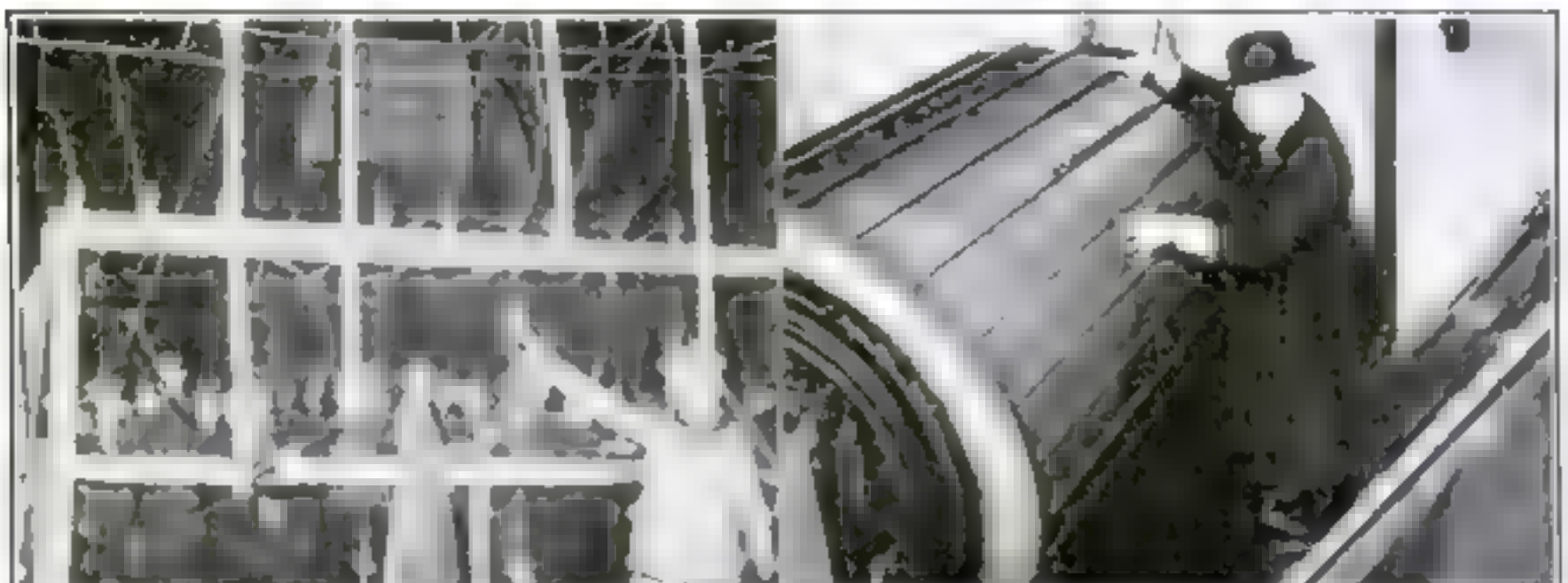
commercial frequencies. Some of the large manufacturing companies have, in recent years, constructed testing transformers for this same sort of circuit, but of only about half the voltage. Only those who have worked with very high voltages can realize the difficulties attending the construction and maintenance of such a special piece of apparatus.

While no one is as yet fully aware of the possibilities of this high power transformer, its electro-static effects are the most marvelous ever exhibited. Strangely enough, the spectators can actually toy with the powerful charges. Crowds of people at a time could walk through an "electrified" area 50 ft. square and 30 ft. in height, yet with no opportunity for dangerous contact. The general arrangements at the Panama-Pacific Exhibition for a demonstration were made in a building with convas end containing the transformer and its controlling accessories, while under the large wire screen suspended by ropes from four electric light poles the visitors could pass and experience the peculiar and vivid sensations of high-voltage charges. Those wearing hat-pins, hair-pins, metal buttons, or carrying metal-handled canes or umbrellas, or even metal-bound purses with their coins, etc., were mysteriously "tickled" and provoked to amusing exclamations of surprise or fright. By holding the hat aloft one could draw sparks from the hat-band; by holding grounded metal conductors at arm's length 12-in. sparks could easily be drawn from the insulated rope safety-screen suspended 10 ft. below the charged screen, each discharge being accompanied by a diminutive thunder-clap. By merely standing on a box or some other insulating material and raising the hand, sparks three to six inches in length could readily be drawn and then passed along to persons standing on the ground Vacuum tubes and incandescent lamp bulbs brought beneath the screen were continuously illuminated with the blue glow peculiar to such influence.

On dark nights the entire aerial system was a mass of soft glowing "corona," the needle-points of discharge, or places of great concentration of electric spray, sizzling with the wonderful wizardry of electrostatics. On some occasions a corona a foot in diameter was observed surrounding some of the metal conductors. When a grounded water-jet spouted upward against a metal disk suspended from the charged screen the resulting luminous display of electric pyrotechnics was awe-inspiring; the length of the luminous discharges measured over 20 ft., while miniature thunderclaps reverberated to surprising distances. Some of these highly entertaining and amusing "stunts" are shown in several of the reproductions accompanying this article.

This is not a mop, which Prof. Thordarson is holding. Sparks are leaping to the top of a pole in his hand. From the safety-screen high-voltage charges and thunder-claps are coming

At left, view of aerial screen system and secondary apparatus for collecting charges. At right, public demonstrating screen suspended thirty feet above ground by four poles



At left, spectators experimenting with apparatus. One boy is waving a vacuum tube. At right, Prof. Thordarson examining his one million-volt, sixty-cycle transformer

Engineers are of course interested in the details of construction of such a transformer, and some of the facts have been generously given by Mr. Thordarson himself and by his assistant and operating expert, Mr. A. S. Lindstrom. The laminated iron magnetic circuit is arranged on the "core" type, with both primary and secondary windings grouped upon one leg only. Horizontal members are 120 ins. in length, the vertical ones 40 ins., their section being 16 ins. by 16 ins. Primary winding consists of 122 coils of 44 turns each of copper ribbon, .020 in. by .281 in. in section, being the equivalent of a No. 12 round wire. These coils are placed ¼ in. apart, pairs being connected in series, then the 61 groups connected in parallel for receiving the 2,200-volt supply. When assembled, the primary portion formed a cylinder 67 ins. long, 23 ins. inside diameter, 28 ins. outside diameter. As a protection from electrostatic surges the junctions between the pairs were connected to a heavy copper bar that was thoroughly "grounded" to frame and earth. Over the primary coils was a specially prepared paper cylinder 92 ins. long, inside diameter 29½ ins., outside 41½ ins., therefore 6 ins. thick.

For the high voltage secondary winding 190 separate coils were used, each adapted for 5,300 volts, being all connected in series. Each coil consists of 212 turns of aluminum foil, .008 in by .135 in., with three thicknesses of .006 in. paper between turns, and when finally assembled forming a tube 71 ins. long, 43 ins. inside diameter, and 51 ins. outside diameter. The construction of this secondary was of course the crucial part of the whole experiment, and the ingenuity that was brought out to cope with the different problems is of the greatest credit to the designer and builder. In general, the principle of construction adopted, that of breaking

up the winding into numerous separately insulated coils, was first utilized by Ritchie, the famous instrument maker, in Boston, as early as 1846, and then copied in the well-known Ruhmkorff induction coils, and now a common affair with all builders of transformers, but the application of the principle in this million-volt winding demanded a refinement of details not heretofore called for. Of course the whole structure required that its windings be protected from absorption of moisture.

A Railroad Which Fights Its Own Fires

THE Transcontinental Railway of Canada is going to fight its own fires in the future. This is saying a great deal, since every other railroad in this country and Canada depends on available city firemen when railroad property catches fire, and when city firemen are not handy allows its property to burn up, helpless to save it because of lack of equipment.

When fires had destroyed valuable timber lines along its right of way and threatened to wipe out whole counties if something was not done to find an efficient means to combat it, the Transcontinental Railway placed an order with the Canadian Government Railways' Shop at Moncton, New Brunswick, for a fire-fighting apparatus. The car illustrated herewith is the result, and it is now in operation.

The apparatus consists of a large water tank of more than ten thousand gallons capacity mounted on a flat car in order that it may be transferred to any point on the system where fire may be threatening. A steam-driven duplex fire pump which has a capacity of three hundred gallons a minute is mounted on the tank. The steam supply for operating the pump is taken from the car heater of the locomotive to which the car may be attached, and by setting the car heater regulator of the locomotive at a pressure of one hundred and twenty pounds per square inch, a water pressure of about one hundred pounds is obtained at the nozzle tip.

Before the apparatus was sent to the Transcontinental Railway the device was tested and found to be capable of throwing two one-inch streams of water a distance of about two hundred feet to either side of the track. This will enable the fire-fighting railroad company to extinguish all fires which occur within its right of way.

The fire fighting apparatus is kept under steam so that it can be quickly transferred to any point on the railroad's system where fire may be threatening property worth millions

Exit the Dinner-Bell; Enter the Flashing Mirror

FARMER'S wives in the great southwest, where ranches are miles instead of acres in extent, have a novel means of signaling the men in the field. Flags, bells and horns are used to announce dinner, but where the distance is too great these means fail, and the farmer's wife resorts to a mirror and the heliograph method.

"On a tour of inspection," writes a telephone man, "I happened to stop at a farmhouse for dinner. The woman who came to the door said that she would call her husband. Upon inquiring where he was she handed me a pair of binoculars and pointed down the valley. I looked and could see the big caterpillar pulling two headers. As it rounded the end of the cutting on its return trip the woman flashed a mirror into the eyes of the driver three times. As I watched I could see the machine come to a stop and presently I saw him coming up the road in his runabout car. He was working five miles away. The woman explained that she learned this heliograph method from the Indians." But suppose it's cloudy?

Calling the men to dinner by signaling with a mirror. But what if it rains?

Why You Can See Two Sides of a Thing at the Same Time

IF you spin a quarter and watch it you will see both sides of the coin at the same time. This is explained by the fact that the senses of man retain impressions a little time It is, indeed, the explanation of motion-pictures. Your vision persists and your perception of objects is continued after the object itself has disappeared. This allows you to see two parts of a thing—even such opposites as the front and back—simultaneously.

War will Diminish the Stature and Vigor of the Human Race

THE most striking end effect of war is race deterioration," comments Dr. George W. Crile, a member of the American Ambulance who served during the first stages of the conflict abroad ("A Mechanistic View of War and Peace," The Macmillan Company).

"The effect of war on the race is seen in the effect of emigration on New England. In stature, in energy, and in enterprise, the New England farmer has deteriorated by losing so many of his fittest sons. It has been stated that Napoleon shortened the stature of the French by several inches. The human animal is not unlike other animals—no one breeds from scrub stock. This war will diminish the stature and vigor of the human race to the extent that the killed were larger and stronger than those who remained at home.

"The birthrate at the end of the war will be changed. It will be increased among the victors, decreased among the vanquished. In this respect man reacts like animals. Animals breed best amidst plenty, less when food and shelter are inadequate, and least of all when harassed in captivity."

Plants on National Forest Ranges Which Kill Cattle

APPROXIMATELY eighty-five per cent of the losses of cattle on the National Forest ranges due to poisonous plants is caused by tall larkspur. Death camas, lupine, laurel, sneeze weed, and rubber weed are responsible for sheep losses from such cause, while loco weed is the principal poisonous plant affecting horses which graze about freely.

A Gasoline-Electric Automobile

COMBINING the utility of both a gasoline and an electric automobile, a new dual-power passenger car recently put on the market by a western manufacturer, may be run by either gasoline or electricity, or both, thus retaining the great mileage ability of the gas car and at the same time the simplicity of the electric.

The power plant of this unique vehicle consists of a small gasoline motor and an electric-motor generator combined in one unit under a conventional hood forward of the dash, and a storage battery carried beneath the rear seats.

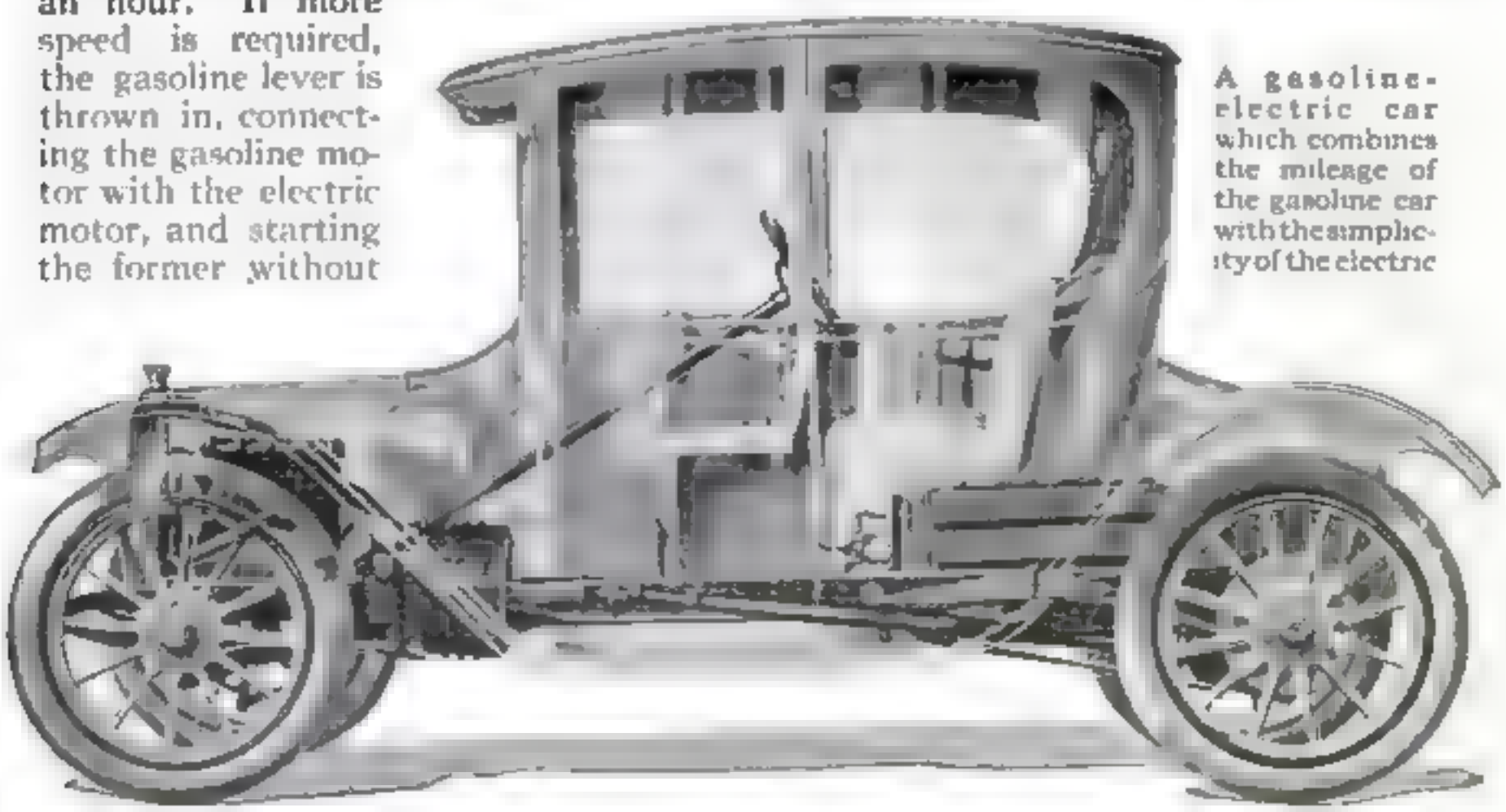
The speed is controlled by two levers mounted on the steering wheel, the power being transmitted through the propeller-shaft directly to the rear axle without clutch, gearset or levers, thus eliminating the trouble of their manipulation and at the same time giving a multiplicity of vehicle speeds. One lever operates the mechanism connecting the storage battery to the electric motor. The other starts the gasoline motor.

The vehicle is started as an electric by moving the electric control lever, which automatically connects the storage battery with the electric motor. As this lever is advanced, the speed of the vehicle is increased up to twenty miles an hour. If more speed is required, the gasoline lever is thrown in, connecting the gasoline motor with the electric motor, and starting the former without stalling. As the gasoline lever is pushed still farther forward, it causes the car to be operated more by the gasoline power, until at a certain point the vehicle operates as a gasoline car, neither charging nor discharging the battery.

By a slight variation of the relative positions of the two levers, the battery may be either charged or discharged at will on any speed from ten miles an hour up to twenty-eight or thirty, the retardation of the electric lever causing the electric motor to act as an electric generator driven by the power of the gasoline motor. The current thus generated is used to charge the storage battery while the car is running.

The same effect may be secured at any speed above six miles an hour by braking through the electric motor when on level ground or when coasting down hills, this being accomplished by a retardation of the electric lever. A conventional brake pedal is provided for braking at speeds less than six miles an hour.

While the two power elements employed in the operation of this car are electricity and gasoline, one supplementing and augmenting the other, it may be run on gasoline power alone. There are no clutches to throw in, no gears to change and no waste of fuel in operating.



A gasoline-electric car which combines the mileage of the gasoline car with the simplicity of the electric

What's the Good of a Hawk?

By Dr. R. W. Shufeldt

OF what use to man is this great army of hawks, harriers, and falcons we see or read about?

There was a time when these "hawks" and their kind were simply regarded as fit subjects for the brush and pen of the professional ornithologist; for the scalpel of the taxidermist, or a legitimate target for every gunner in the land that came across them in the open.

There is a splendid array of falcon-birds in our avifauna, the principal representatives being the Eagles, the Falcons, the Hawks, Kites and Harriers. Besides these, we have two species of Caracaras, as well as the famous Osprey or Fish Hawk. When one includes the latter, with the four different kinds of Eagles recognized by American ornithologists, there are in the United States, all told, no fewer than thirty-two species and twenty-one sub-species of such birds. None of these are as abundant as they were half a century or more ago, or even less time. Indeed, during the autumnal migration of birds southward in the early seventies, in the southern part of Fairfield County in Connecticut, I have seen as many as a thousand or more different kinds of hawks pass overhead in the course of a day; I very much doubt that one now could count, at the same time of the year, over a hundred.

Profile of the Osprey or Fish Hawk which lives entirely upon fish and other water food

The thoughtless farmer argues that hawks of every kind kill domestic poultry, and that he, for one, is for exterminating the entire lot of them. That thousands of chickens, ducks, young turkeys, tame pigeons, guinea-fowls and other denizens of the farmer's yard, have been, in time, destroyed by hawks, there can be no question; but even so, our investigation of such a serious matter should not rest upon a snap judgment, and lead us to condemn the entire tribe on that account.

In the first place, some hawks, as the Fish Hawk, live entirely upon fish, and never attack or destroy any kind of fowl or mammal, although it has the strength to kill a full-grown gobbler, were it to try to do so. The illustration here given is the reproduction of a photograph I made of a bird not quite full grown, which was in my possession for several days; I also made the other photographs for this article from living specimens of hawks in my keeping at different times. In so far as man's interests are concerned, the Fish Hawk or Osprey is entirely harmless.

All those hawks which we call Kites do not, as a rule, attack birds or quadrupeds of any kind, and *never* domestic poultry. They destroy, however, in the course of a year, millions of noxious insects and no end of vermin, which prey

upon the crops of the agriculturist. Still other species of hawks, as the Duck Hawk, prey entirely upon feathered game, and never come near the barnyard. Birds of that class do no more than we do ourselves—hunt ducks for food.

That a number of species of hawks do constantly prey upon both the old and young of various kind of domestic fowls, there is no question; moreover, they feed upon a large number of them in the course of a year. Still, no individual poultry-raiser or farmer loses a sufficient number of his fowls annually, through the attacks of hawks, either to impoverish him or so far embitter him as to cause him to be the enemy of every hawk of every species in the country. To follow such a policy is an extremely grave error; it would be like exterminating all snakes and owls for the reason that a *few* snakes are venomous, and the *larger* owls occasionally capture a domestic fowl. If we consider *all* the snakes and *all* the owls as a group, they save from damage and destruction farm products to the extent of many millions of dollars annually. The pity is that they are so constantly preyed upon that they cannot accomplish results to be appreciated by us.

The Broad-Wing Hawk which preys upon mice

A very young Sparrow Hawk in its fledgeling covering

Full-grown Sparrow Hawk—one of the farmer's feathered friends

Wolves of the Sea that Abound in Cuban Waters

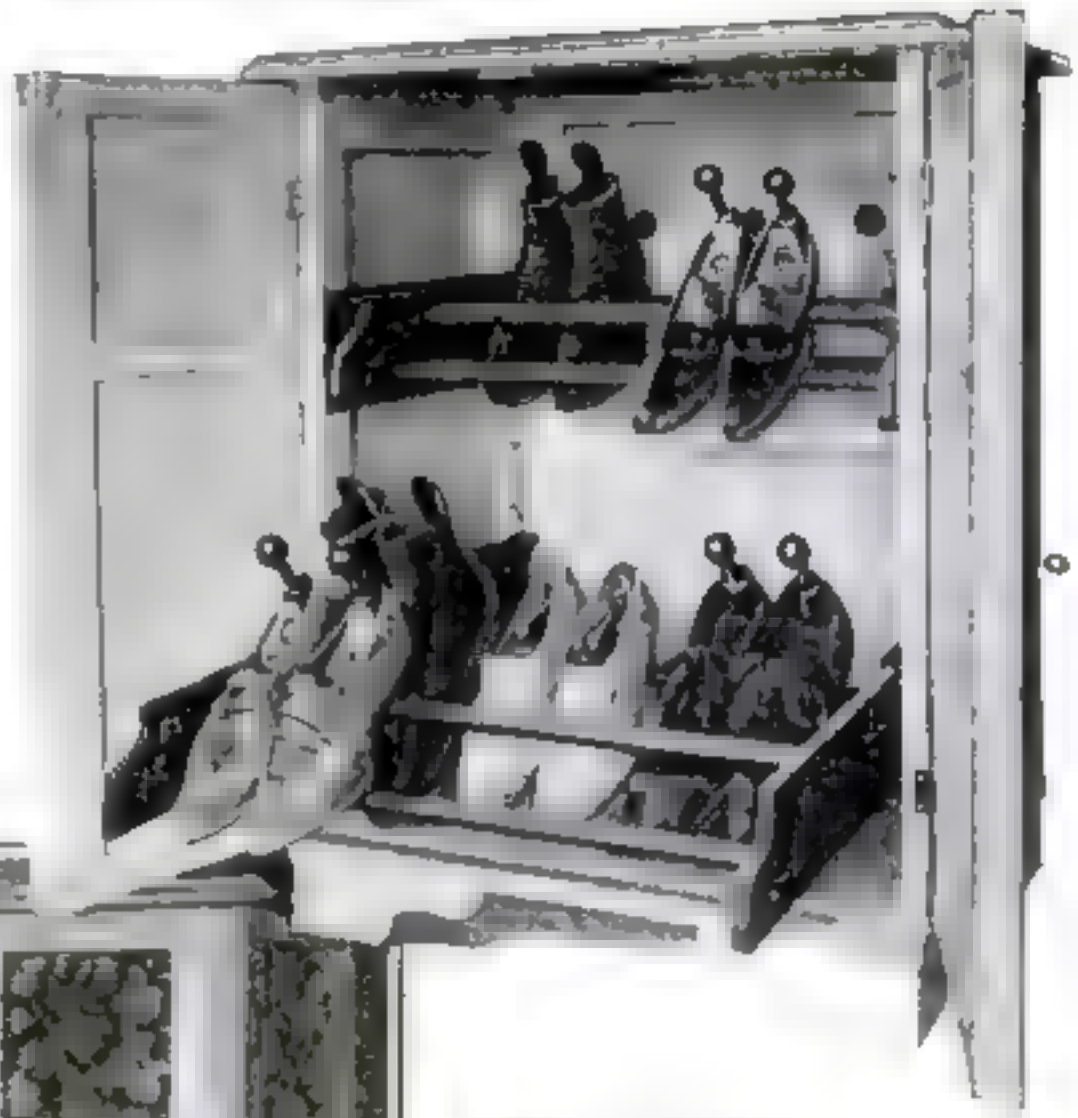
FACTS appear incontestably that sharks, and big ones, abound in Cuban waters; that thousands of swimmers are never attacked; and that there are perfectly authentic instances of people being maimed or killed by them.

The Antillean shark is less dangerous than some Australian and South Pacific species. In clear water of fifteen or twenty feet depth he is timid. Near a boat anchored where the bottom can be seen from the surface, as in those waters it commonly can be at the depth named, the bather is safe. In deeper water there is risk. If there is blood in the water from a wounded man or fish, the swimmer's peril is great. Indifferent, lazy creatures, of a low order of intelligence, sharks are instantly frenzied by the presence of blood, and will attack anything that moves.

More than the sharks, the Barrera cruisers fear, when inclined to a morning plunge, the picoua, a big and aggressive fellow with a protruding jaw fitted with long, sharp teeth. Lying motionless near the bottom in rocky retreats about the offshore reefs, he darts at his prey with remarkable swiftness. His sinister appearance has given him an evil reputation.

A Handy Shoe Cabinet for the Whole Family

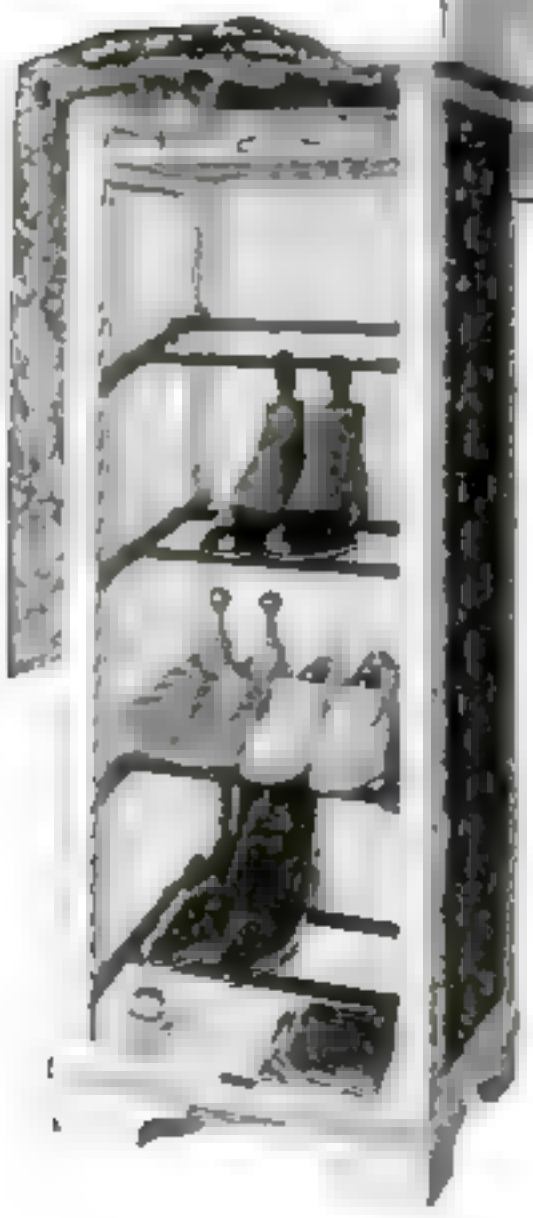
A GERMAN woman who claims to have gained her idea from practical experience has designed and patented a shoe closet which may appeal to the "cliff dwellers" of large cities or in fact to any persons with whom space in the home is at a premium. Fashions demand a staggering variety of footwear, and the favorite custom of stowing them neatly away under the bed or in the corner of a closet where they may gather dust is not only inefficient but costly. Inefficient because the shoes wanted usually evade the eye of the wearer, and costly because shoes do not improve with dust.



Above, the interior arrangement of a neat and compact cabinet large enough for two persons

At right, the shoe cabinet for the family. This one is ornamental enough but it is not at all costly

Below, the cabinet reduced to a size for keeping the shoes of one person. The four shelves are each adjustable



A cabinet of simple design for the family. It is polished and finished in white enamel

The shoe cupboard designed by the German lady would in appearance if nothing else, improve almost any home. It is compact and shapely with nicely enamelled sides and swinging doors. Neat little racks are provided to hang the shoes on, and ventilators in the back wall insure proper cooling. The shoe wardrobe can be attached to the wall, placed upon the floor or upon a small stand or table, as convenient. If desired, it can be built in a clothes-closet which affords ample room for its construction, or it may be used as a storage closet in the maid's or children's room.

Above, a party enjoying a ride on the water with the new water-shoes. The paddles are used to steer and not to propel the shoes. At left, an Italian soldier operating his water shoes and shooting his rifle

The mechanism of the water-shoe, showing the mounting of the paddle wheel on the pontoons

"Canal Boats" Which Are Real Water-Shoes

An Italian [illegible], Luigi R[illegible], of Genoa, has invented an ingenious form of water-shoe to which he gives the name "hydro ski." Compared with so-called water-shoes or skis already on the market it differs in the method of propulsion. Unlike forms introduced in the past, the present shoes, which are canvas pontoons, are provided with two sets of cross arms or axles to which paddles are fitted at their extremities.

It will be noted in the illustration that the paddle is fastened to one pontoon by means of an eccentric axle, and to the other pontoon by another eccentric axle. These axles are not in alinement, so that by shifting the weight of the body from one shoe to the other alternately, the paddle wheel is turned at a fair rate of speed with very little effort. Steering is facilitated by the use of a double-blade paddle, which also enables the operator to maintain his balance.

A Venetian Barge in Boston

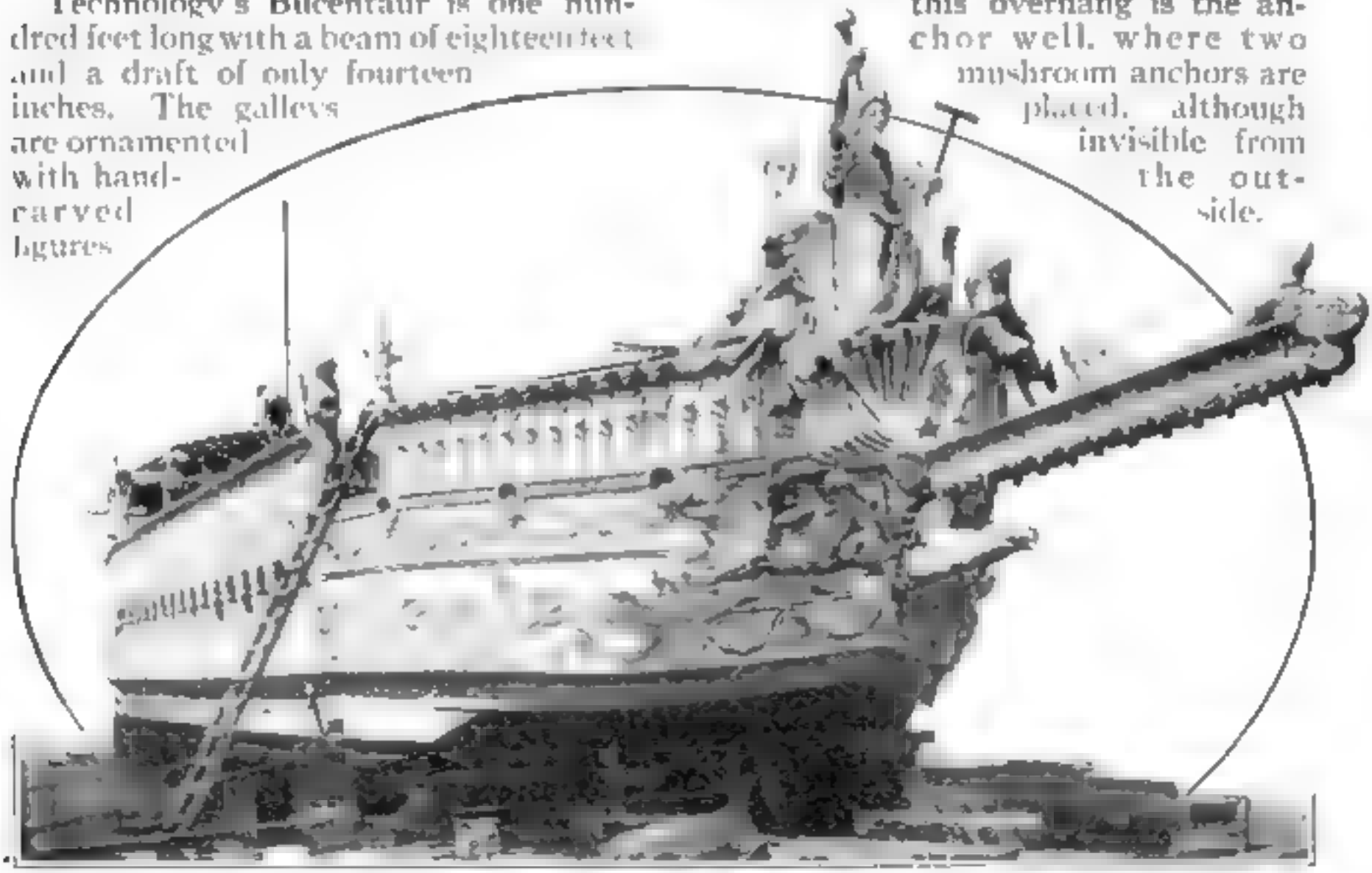
A STRANGE looking craft made its appearance recently on the Charles River. It was an exact replica of the state barge of Venice used annually by the doge in the ceremony of the marriage of the Adriatic. It led the procession in the water festival at the exercises when the transfer from the old to the new Massachusetts Institute of Technology buildings in Cambridge was made.

The barge was named "Bucentaur" after the old Venetian name. The last Bucentaur or state barge was built in 1729 and was later destroyed by the French. The ancient ceremony was instituted after the victory of the Venetians over the Imperial Fleet in 1177, on the gift of a gold ring by Pope Alexander Third to the doge as a token of the city's dominion over the sea. It was celebrated annually on Ascension Day, the doge casting a consecrated ring into the sea from the Bucentaur or state barge. The Venetians called the ceremony an "espousal of the sea."

Technology's Bucentaur is one hundred feet long with a beam of eighteen feet and a draft of only fourteen inches. The galleys are ornamented with hand-carved figures of wood in white and gold. At the bow is a massive figure, the symbol of the Institute of Technology. It is a woman in whose left hand is held a T-square and whose right hand holds aloft the torch of enlightenment.

On either side of the waist of the odd craft is an ornamental frieze more than fifty feet in length, made up of realistic-looking sea-horses, dolphins, mermaids and cupids, at play in the waves. On the main deck, at the stern, is a deckhouse with an arched roof supported by caryatids in groups of three. The flagstaff is erected at the forward end of this deckhouse. In all more than fifty figures were used in the ornamentation of the galley.

The barge was constructed on the suggestion of Professor Ralph Adams Cram. It has a twelve-horsepower gasoline engine to drive a propeller of twenty-four inches as an aid to the rowers. The whole superstructure is built upon what is practically a scow, the prow forming the overhang. Over this overhang is the anchor well, where two mushroom anchors are placed, although invisible from the outside.



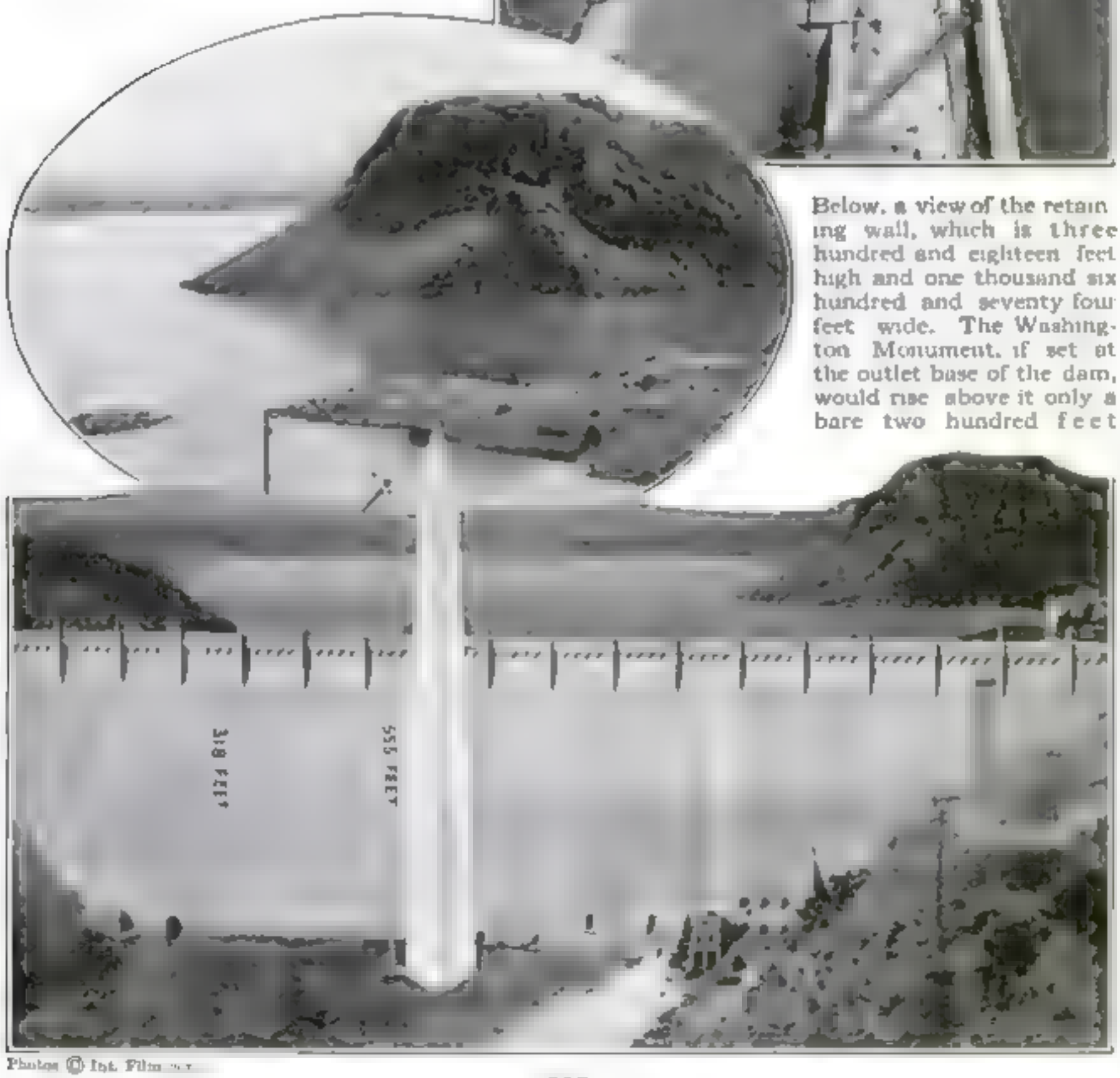
The Bucentaur led the procession in the water festival on the Charles River, when the transfer from the old to the new Massachusetts Institute of Technology buildings was made

Uncle Sam's New Dam at Elephant Butte

At right, the storage dam at Elephant Butte, New Mexico, built by the United States Reclamation Service for the irrigation of thousands of acres of desert land. The dam was completed May 13th at an estimated cost of five million dollars. It stores eight hundred and fifty-six million gallons of water

In oval below, a general view of the dam looking East. The great body of water covers a complete range of low-lying hills and valleys several hundred feet deep. For the quantity of water stored it is said to be the greatest storage dam in the world. It holds enough water to cover the State of Connecticut to a depth of ten inches

Below, a view of the retaining wall, which is three hundred and eighteen feet high and one thousand six hundred and seventy four feet wide. The Washington Monument, if set at the outlet base of the dam, would rise above it only a bare two hundred feet

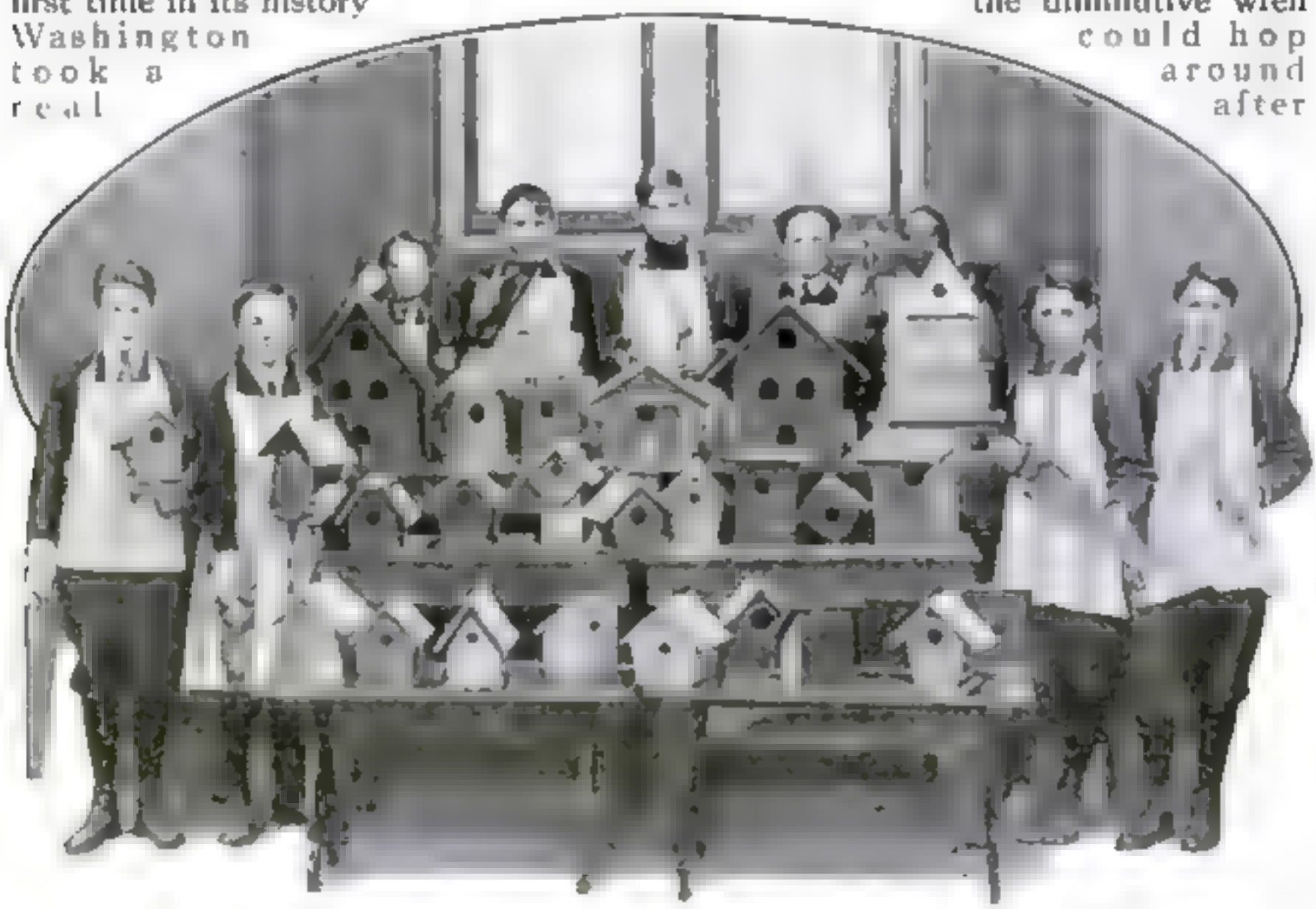


Photos © Int. Film ...

Building Houses for Birds—A

At the first birdhouse building contest held in this country, in the State of Washington, seven hundred and eighty-two birdhouses were built by as many boys. During the one day

IN the Puget Sound country the severest winter of the last quarter century has been productive of a new constructive work, acquaintanceship with, and love for birds. For the first time in its history Washington took a real interest in its songsters. People everywhere fed and watered the birds. Backyards were scraped free of snow so that the robins, thrushes, blackbirds, bluejays, snowbirds, and even the diminutive wren could hop around after



Twenty five different models of birdhouses built by boys from one school in the Washington contest. There are no two models of the same type and the designs are all original

New Countrywide Movement

of its existence twelve hundred people paid to see the exhibit. From this auspicious beginning the movement assumed national proportions, spreading to all parts of the United States

rations. In addition to this the government maintained a "bird station," and the man in charge, Harry Dillaway, got the school children interested in a birdhouse building contest, with the result that a birdhouse exhibit—the first of its kind ever held, attracted favorable attention from bird lovers all over the country.

When the exhibit was opened seven hundred and eighty-two future homes for birds greeted the visitors. The houses ranged all the way from the humblest of cottages to the finest of mansions, and every one was in the prize-winning class. Many of the houses were ingeniously constructed, and not a few combined ideas of beauty and arrangement so novel as to warrant special mention.

To cover the incidental expenses of the exhibit an admission charge of ten cents for adults and five cents for children was made. During the one day of its existence there were twelve hundred paid admissions.

The contest created a love for birds and stimulated a vital and permanent interest in the home workshop

Lubricating Your Automobile

By Waldemar Kaempffert

AN automobile engine is a heat engine. The gasoline is drawn into the cylinder in the form of vapor, which consists of about one part of gasoline to eighteen parts of air. The vapor, when it comes in contact with the electric spark, explodes, or, more properly stated, burns with flash-like rapidity. Anything that burns generates heat, and when heat is generated the surrounding medium expands. It is simply the expansion of the medium in the cylinder, produced by heat, that forces the piston down against the crankshaft and ultimately turns the wheels of the automobile.

The temperature at the instant of explosion is between 2000 and 3000°. If it were possible to convert the heat represented by that temperature into work, the automobile engine would be marvelously efficient. But we have not yet learned how to handle that heat. We must waste some of it by cooling systems to save our automobiles from destruction; otherwise the cylinders of a motor would be reduced to a mass of molten metal.

The lubrication of an automobile is a particularly difficult problem because the gasoline motor is so peculiar a heat engine. It is the object of lubrication to keep rubbing surfaces apart. But if the lubricant is a film of oil, often less than three one-thousandths of an inch thick, as in a gasoline engine, and the rubbing surfaces are very hot, how is it possible to attain that object? It seems almost incredible that lubrication is possible at all in an automobile, once the physical problem is stated.

A prominent automobile manufacturer has brought out a motor which has a speed, under certain conditions, of 3400 revolutions a minute. An equally prominent refiner of oils has visualized these figures in a way that shows what is demanded of a lubricating oil. During a single minute, he points out, each cylinder passes through the four cycles of intake, compression, power and exhaust no less than 1700 times! More than 28 complete cycles in each cylinder, or a total of 171 complete cycles in all six cylinders within a single second! Every second the carbureter must furnish 171 complete charges of gas—the magneto 171 individual sparks; and 171 times in a second the temperature at the instant of combustion reaches the almost inconceivable figure of nearly 3000° Fahrenheit. During each second the six pistons, each with a stroke of 4½ inches, travel a lineal distance of 255 feet, rubbing over a surface equivalent to a path 255 feet in length and 10⅛ inches in width—a total area of 216¾ square feet a second.

Friction and Lubrication

The object of lubrication is, of course, to overcome friction, and friction in automobiles is due primarily to inequalities which are always found in the most highly polished surface. Even the smoothest piece of glass, when viewed under the microscope, is incredibly rough, and so are the apparently smooth walls of a cylinder and the surfaces of the piston rings and the piston. Press two apparently smooth pieces of metal together; then slide them in opposite directions; the two "seize"—interlock; the inequalities on the surface of the one intermesh with those of the other. Friction is produced, which means that heat is generated. Heat causes a metal to expand. The pressure on the outer surfaces does not permit of expansion outward. "Seizing" results. That is why it is the function of a lubricant to keep the surfaces apart.

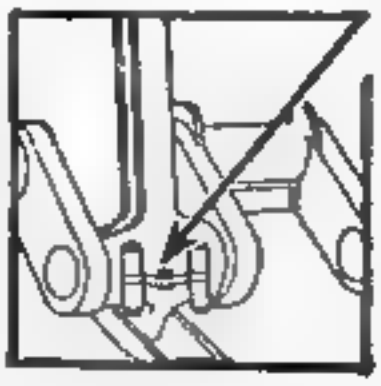
Try to keep a red hot stove wet with dropping water, and you will realize the difficulty of lubricating a hot automobile motor. The greatest enemy of lubricating oil is heat. Hence of two oils that which loses little lubricating value under relatively high heat is the more suitable for automobile lubrication. Consider the temperature to which oil is subjected in a motor and you will under-

stand how important it is to consider the destructive effect of heat. When the spark ignites the fuel charge in the combustion-chamber the heat of the explosion is at least 2000° and even 3000°; the inner cylinder wall surfaces may be as hot as 350° and certainly no cooler than 180°; the piston heads may not be hotter than 300° but are more likely to be 1000°; the main shaft and crankpin-bearing oil varies in temperature from 140° to 250°; and the sump oil has a temperature of 90° to 150°.

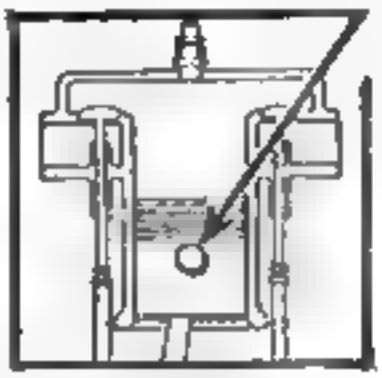
What Happens When Oil Is Heated

Oil is a chemical compound of extraordinary complexity. The number of elements of which an oil is composed are few, but the number of ways in which these elements can be split up or combined is almost limitless. The properties of lubricating oil are dependent on the many chemical compounds present in the oil. Destroy that stability (the application of heat is the surest way of accomplishing this), and the oil ceases in part to be what it was before heating, both chemically and physically. The change which takes place in boiling an egg is not so great as that which takes place in an oil exposed to high temperatures.

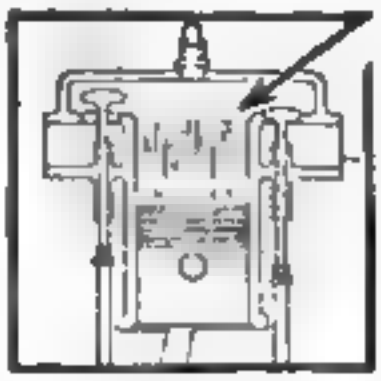
After an oil has been used in a motor for a few hours it changes entirely in color. Yellow originally, it becomes blue, and, after the motor has run for several days, it turns black What is more, a black deposit settles out—a deposit which consists of metal dust, rubbed off the friction surfaces, carbonaceous matter, and powder-like carbon. Of these the most destructive in their action—for oil is used over and over again in a motor car—are the metal dust and the carbon. They



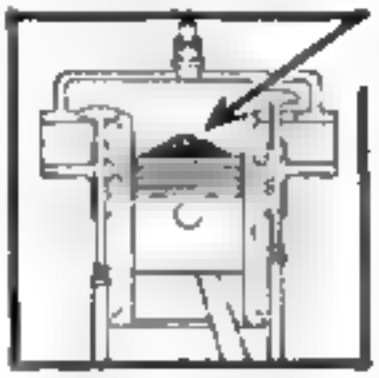
When the wrong oil is used the connecting rod bearings wear away



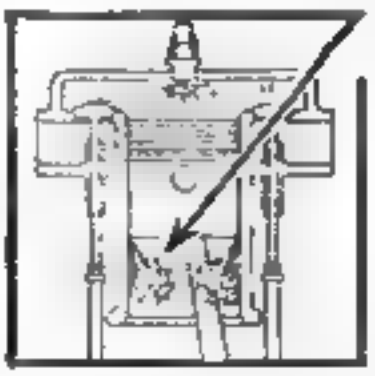
Worn wrist-pins result from bad lubrication



Cylinder walls are scored when lubrication is poor



Carbon deposits are formed when the oil works past the piston rings



Too light an oil causes leakage of gases

cut like sand, and their effect on the bearing surfaces can therefore be imagined. Since this powder-like carbon is deposited as the result of heat, it is important that a heat-resisting oil be used. Unless an oil has the right physical and chemical properties it may do more harm than good in a motor. Oils are therefore tested in half a dozen different ways to ascertain their suitability for automobile lubrication. Some of these tests can be conducted only with scientific instruments; others can be made by anyone.

The Flash Test and What It Means

No oil can withstand the enormous temperature of 2000° and even 3000° to which it is subjected on the wall-surfaces of a motor during the brief moment of explosion when the piston is driven outward on its working stroke; fortunately the period of exposure is so short that only the outer layers, so to speak, of the oil are affected

Above a certain temperature the vapors arising from an oil are inflammable, and the flash test consists simply in determining the temperature at which they will ignite without setting fire to the oil itself. A small test flame is brought quickly near the surface of the oil, contained in a little test cup, and as quickly removed after ignition of the vapors. The temperature is measured. If the flash point is much below 400° the oil is unsuitable for efficient lubrication, because it will obviously flash off the surfaces and also evaporate too quickly and will not last long.

A certain amount of gasoline always finds its way into the crankcase where it mixes with the lubricating oil. Since gaso-

line is highly inflammable it follows that both the flash and fire points of used oil are lowered below the normal flash temperature.

The Fire Test

The temperature at which an oil will ignite from its vapors and continue to burn, called the "fire test," is not of much use in testing fresh oils, but it does reveal much about an oil which has been used in an automobile. Heat tends to decompose an oil chemically into its lighter and heavier constituents, and the crankcase of some motors is always hot enough to affect an oil. The lighter constituents will ignite at a much lower temperature than the original lubricating oil. Hence, by applying the simple fire test, which consists in bringing a test flame quickly to the surface of the oil and allowing first the vapors to ignite and then the oil to catch fire from the vapors, it is possible to determine to what extent the oil resists heat. This applies chiefly to used oil. An oil that fails to meet the test satisfactorily will be used up very rapidly; it will be vaporized too easily.

Viscosity or "Body"

Of equal importance to the flash or fire test, is the determination of an oil's body—its viscosity. Water, which has very little body, is clearly less viscous than cane syrup. It is possible to measure viscosity by measuring the rate of a liquid's flow. Special instruments have been invented to measure that flow in a given number of seconds under a given head or pressure and at a given temperature. Viscosity is therefore usually expressed in seconds at a given temperature. If the oil is too light, has too little body, the rubbing surfaces will not be properly separated. Hence, an oil must be selected of such viscosity that it will reduce the fuel consumption for a given amount of power to a minimum and yet prevent the pistons and bearings from "seizing." That selection results in a compromise between the attainment of proper lubrication and of the utmost fuel economy. The point of compromise lies somewhere between 180 and 800 seconds, depending on the conditions under which the motor is operated and the particular design of the motor.

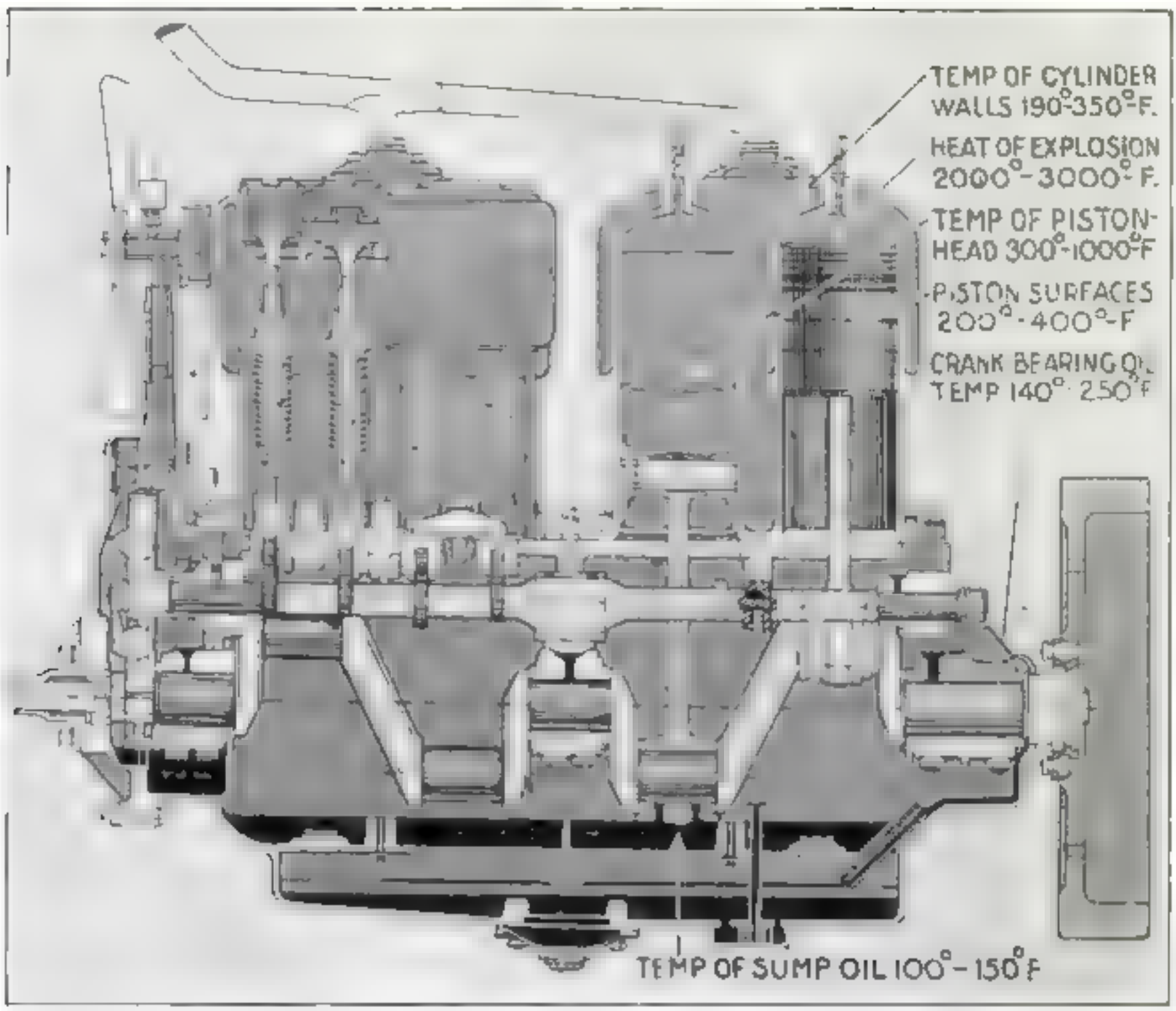
The Carbon Residue Test

Another test consists in measuring the carbon residue after complete distillation in a small flask. Every oil will leave a carbon residue, as it must, because oil always contains a certain amount of "fixed" carbon. The amount and character of the carbon left, however, is an indication of the grade of petroleum from which the lubricating oil was distilled and the care exercised in refining. All oils oxidize or polymerize when heated, forming sediment, the nature of which tells much about an oil. The heat of many explosions causes part of the film of the lubricating oil in the cylinder to flash off and to escape with the exhaust gases. A residue, commonly called carbon deposit, is left behind, however, consisting of carbon, solid hydro-carbons, etc. Oil must be continuously fed in to renew the thin film. It is evident that by testing an oil by heating it in a tube over a Bunsen flame, we are subjecting it to a condition something like that which it must meet in an automobile motor and that decomposition must always result whenever oil is called on to endure heat. The duration of the heating and the temperature, of course, affect the outcome of the experiments. Some manufacturers claim that they make "non-carbon" oils. An oil is composed of hydrogen and carbon in a chemical combination, just as water is a chemical combination of hydrogen and oxygen. It is just as absurd to speak of "non-carbon" oil as it is to speak of "non-oxygen" water.

Tests for the Automobile Owner

One of the easiest tests, which every automobile user can make for himself, is that which shows how the oil stands up under heat. A small quantity of the oil is heated over a Bunsen burner in a test tube until yellow vapors appear which will be in about fifteen minutes. If the oil turns black it is unsuitable for automobile lubrication; if it darkens but still remains clear, it is good.

Another test, easy to carry out, consists in shaking equal quantities of oil and water in a bottle for half an hour—the emulsion test. A poor oil (in part or wholly) mixes permanently with the



In many cars the Splash Lubricating System is employed. Oil is supplied to the crankcase. The connecting rods dip into and splash the oil to all other parts of the engine. The temperatures of the various parts are indicated in the diagram and show the heat to which the lubricating oil is subjected. The parts that are lubricated are indicated in white

water and has a curdled appearance; but good oil shows a clean line between the oil and the water. The test indicates whether or not the refiner has removed harmful acid compounds and other impurities.

Of all these tests those which indicate an oil's viscosity and heat-resisting qualities are the most significant, because they show whether or not an oil is able to form and maintain the film that separates the friction surfaces and prevents the escape of gases past the piston during the compression and power strokes.

The accompanying pictures show what happens when poor, cheap oil is used in a motor car—an oil which fails to meet the tests mentioned. If the oil has insufficient body and cannot stand heat, metal rubs on metal; piston rings break; the cylinder walls are scratched and scored.

An oil of low viscosity is easily sucked past the piston rings into the explosion chamber. That means compression losses, because of the poor gas seal formed by the oil. What is more, the carbon of the oil—the carbon which is an indispensable chemical constituent of every oil—is deposited in a more or less thick coat. Subjected to the heat of thousands of explosions in a few minutes, this carbon acts like so much coal. Parts of it become incandescent. Hence, mixtures are prematurely exploded. "Knocking" of the motor results, which means that the glowing carbon ignites the mixture before the piston has reached the top dead center, thus giving rise to powerful blows

on the bearings and the delivery of power in the wrong direction. A trip to the repair shop inevitably ensues, with a big bill.

An oil which has not been selected with a due regard for the requirements of the cylinders is bound to affect the bearings. Unnecessary wear of the main or connecting rod bearings is caused by poor quality of the oil, or by an oil too light in body, or by an oil too heavy in body to reach the friction surfaces, or by an oil unsuited to the method employed for supplying it to the bearings. When each revolution of the crankshaft is accompanied by a dull thump, you may be sure that this wear is manifesting itself.

Selecting the Right Kind of Oil

The lubricating system of the automobile ought to be but is not standardized. No less than ten different mechanical methods of lubricating automobiles are in use on the various cars made in the United States. Some day the Society of Automobile Engineers will specify one lubricating system for all makes of cars, and when that time comes it will be easier than it is now to select the right kind of oil. As it is the lubricating requirements of each make of car must be studied—a study which involves the construction of the engine; horizontal, vertical, or V type of cylinder arrangement; two or four stroke cycle; bore and stroke; valve construction and arrangement; oiling system; number and fit of piston rings; piston clearance; condition of the bearings; cooling system (air and water); engine speed; and climatic conditions. It is evident that the average automobile owner cannot be expected to have either the engineering experience or the technical knowledge required to consider all these factors. Fortunately the leading oil refiners have made elaborate and special studies of the many motor cars on the market and have prepared lubricating charts, which can be obtained for the asking and which show exactly what oil should be selected for any given make of car. In a few years from now lubricating systems may be standardized with the result that a single oil will answer for all motors.

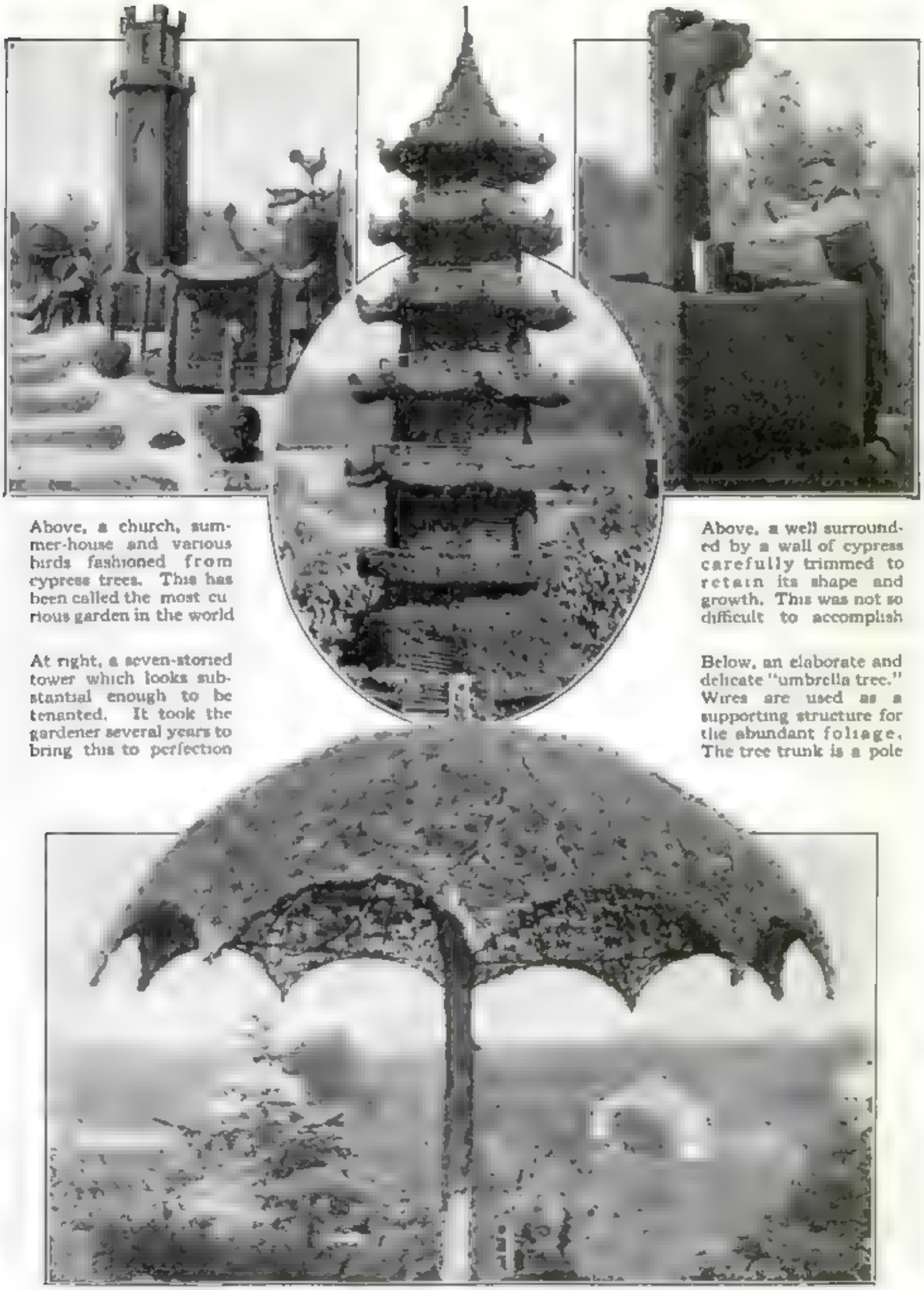
A well-known motor car manufacturer has given it as his opinion that fully seventy-five per cent of automobile repairs and fifty per cent of depreciation in automobiles may be attributed to poor lubrication. A car costing $850 is operated at an annual cost of $416. Of this sum depreciation, repairs, and fuel are represented by $286. The amount of lubricating oil required in a year does not cost more than $10. It is the wildest kind of folly, therefore, to save money on the small amount of lubricating oil required to keep down the expense for repairs and depreciation. Cheap oils mean repairs, and repairs mean heavy bills.

Spontaneous Explosions Due to Microscopic Plants

EVERY little while an explosion occurs in a subway, sewer or trench or in an electric-wire tunnel or some other subterranean conduit or passageway under such circumstances that it is exceedingly difficult to determine the cause of the accident satisfactorily. Such explosions have often been attributed to sewer gas, which contains a considerable proportion of methane and hydrogen. These gases are exceedingly combustible and quite capable of exploding with extreme violence when mixed with air in the right proportion and fired with a spark or a flame. This much is quite generally admitted; but in many cases the difficulty is to account for the ignition of the mixture, when it appears to be impossible to ascribe it to the action of any recognizable external agent, such as electricity or flame.

It is well known that, during the decomposition of the organic matter in sewage, microscopic plants of a certain kind grow in the mass and act upon it in such a way as to cause about two-thirds of it to liquefy, while the remaining third remains in the solid state. When the conditions are favorable, phosphine gas is occasionally generated in the course of the bacterial action; and this gas, when impure, has the peculiar and unusual property of taking fire spontaneously upon coming in contact with the air. Such a fire spreads with great rapidity.

A Quaint Cypress Tree Village in Paris



Above, a church, summer-house and various birds fashioned from cypress trees. This has been called the most curious garden in the world

At right, a seven-storied tower which looks substantial enough to be tenanted. It took the gardener several years to bring this to perfection

Above, a well surrounded by a wall of cypress carefully trimmed to retain its shape and growth. This was not so difficult to accomplish

Below, an elaborate and delicate "umbrella tree." Wires are used as a supporting structure for the abundant foliage. The tree trunk is a pole

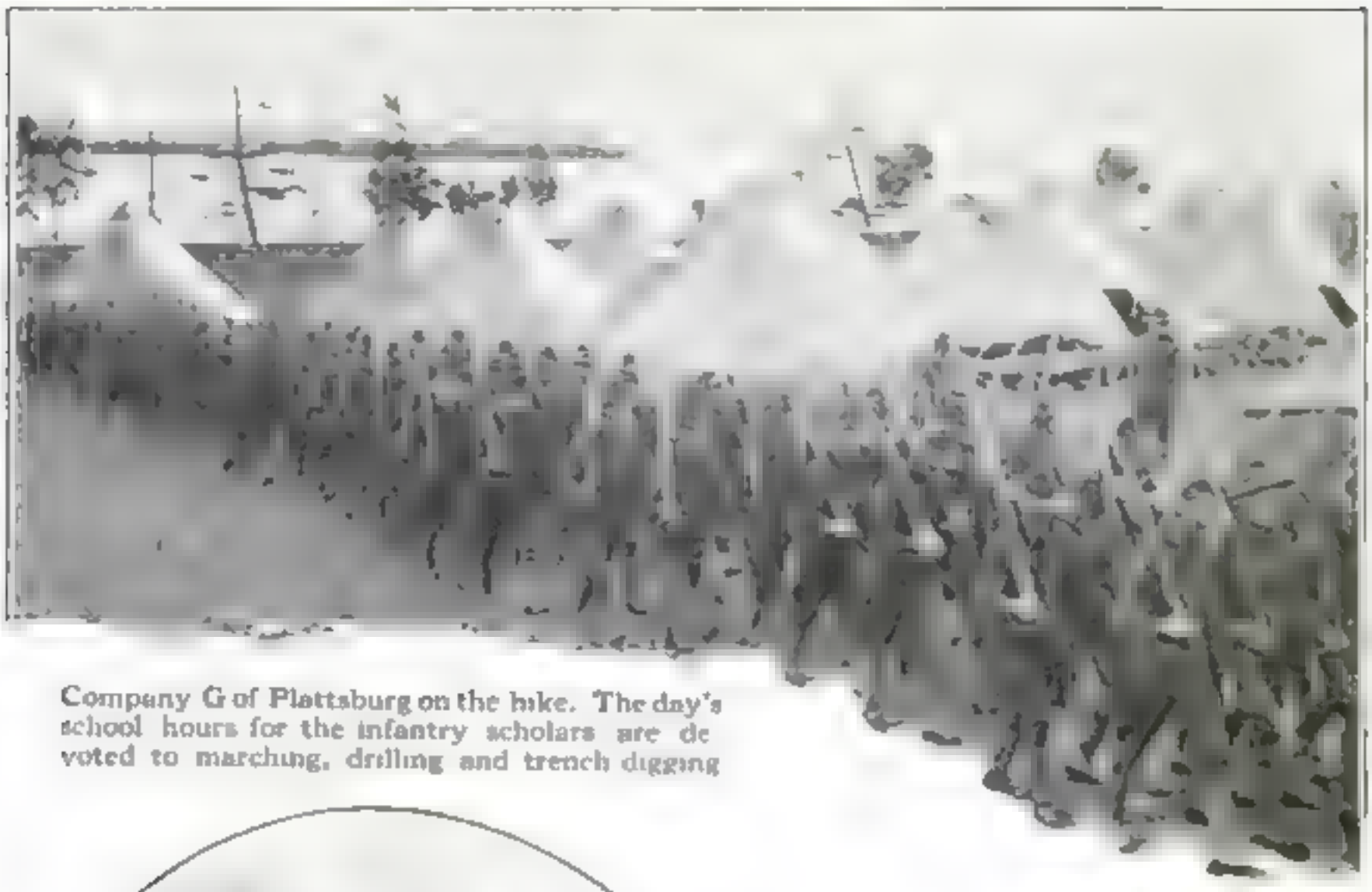
Putting the Unprepared "Rookie" Through

A case of unpreparedness. Dr. M. J. Murphy couldn't find a uniform big enough to fit him. He has to drill in his civilian clothes

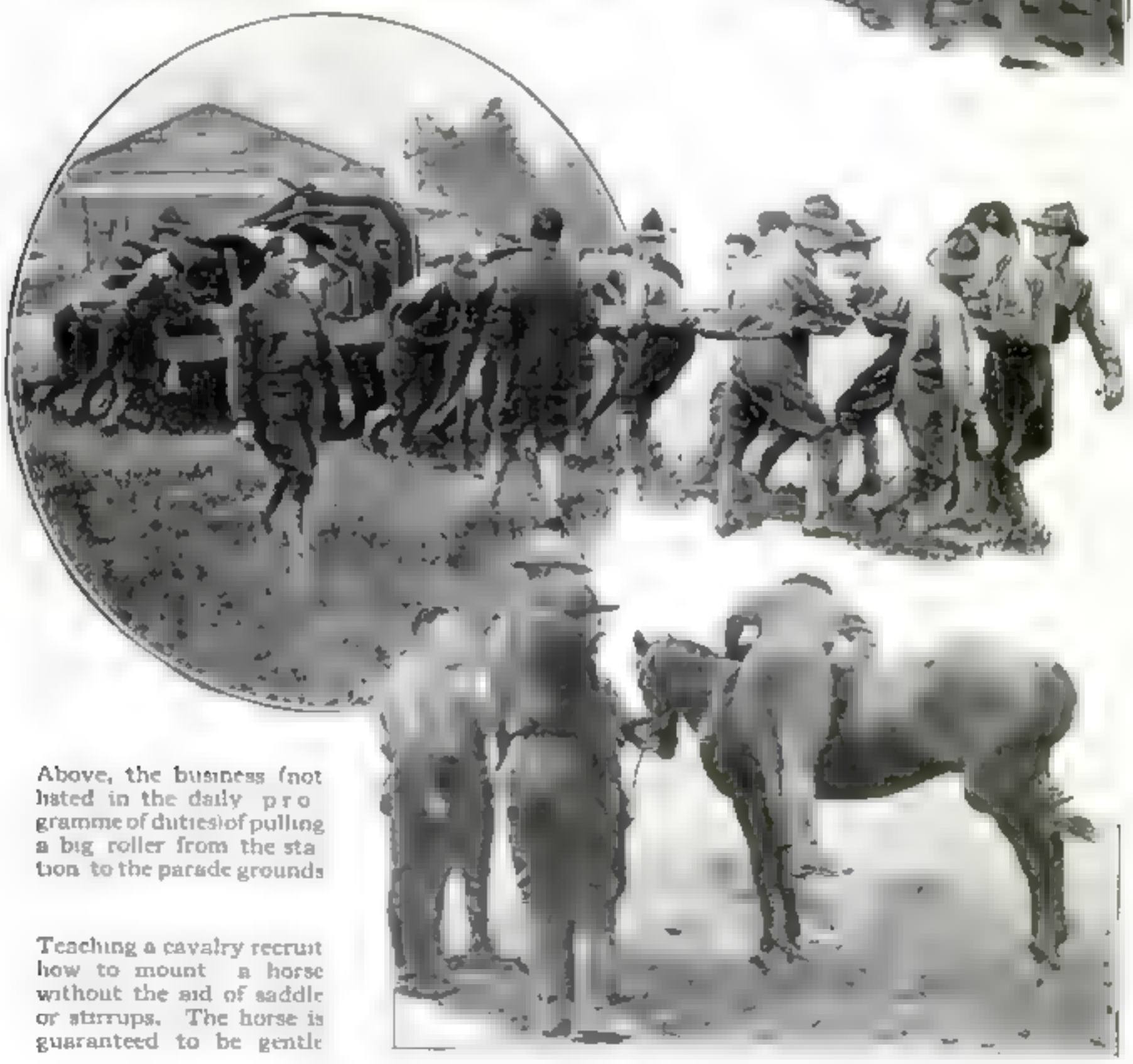
At top, examining the men with the stethoscope. A staff of army surgeons is in attendance to see that every "rookie" measures up to the stringent physical requirements of the Army before pronouncing him physically "fit

In oval, teaching a future guardsman how to chop wood. "How to Do the Chores," is one of the most unpopular courses now being taught rich men's poor sons at Preparedness's Plattsburg. On the other hand, a popular course is the class lecture, which is always well attended

the Preparedness Mill at Plattsburg



Company G of Plattsburg on the hike. The day's school hours for the infantry scholars are devoted to marching, drilling and trench digging



Above, the business (not listed in the daily programme of duties) of pulling a big roller from the station to the parade grounds

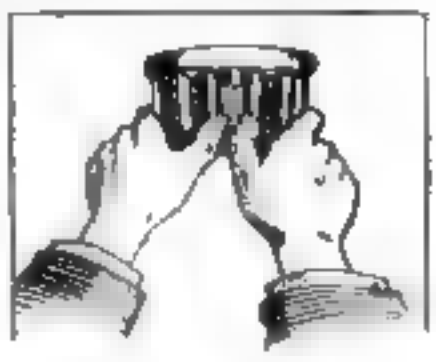
Teaching a cavalry recruit how to mount a horse without the aid of saddle or stirrups. The horse is guaranteed to be gentle

What's New in Patents

Pipe Loaded From Stem

A DETACHABLE pipe in which a specially prepared roll of tobacco is loaded in the stem instead of the bowl is said to afford a cool and non-biting smoke. Air is drawn in to the burning tobacco through the bowl, and as it is packed up tight against the stem nicotine cannot enter the smoker's mouth. When the roll of tobacco has been smoked the bowl is detached from its stem and the ashes are removed from the loading end.

Automatic Roller Bearing

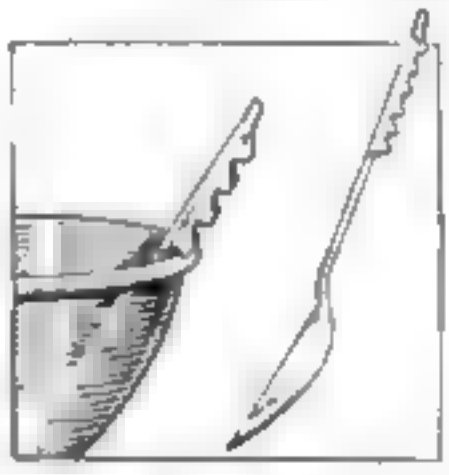


A ROLLER bearing combining balls and rollers in a manner which automatically compensates for variations in roller diameter has been devised. The balls are placed in the bearing in two rows, as indicated, and permit of the automatic adjustment of the rollers. The concentricity of the bearing itself as well as of the bearing upon its mounting and its housing is secured without compelling extensively close limits in machining.

Spout Attachment for Bottles

AN attachment applied to the mouths or necks of bottles directs the pouring of the liquid and serves to catch the drip It is constructed of any suitable material, such as celluloid, sheet metal or the like, and is inclined downwardly and inwardly from its outer toward its inner edge. The arms attached to the spout are provided with loops or eyes to facilitate a clamping engagement.

A Spoon That Can't Slip



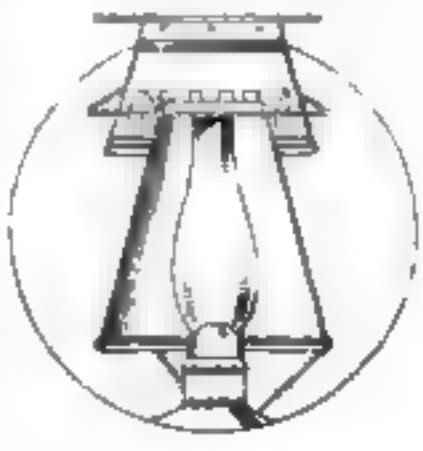
A SPOON has been invented with teeth or serrated edges to enable it to hook upon the edge of a dish and stay in any position in which it is placed. The teeth are in the handle and are so arranged that they do not interfere with the operation of the spoon. The spoon can not slip down the edge of a pan or dish and become emerged in the contents. Furthermore, it will retain heat as readily as the ordinary spoon.

A Fancy Shoe-Lace Cover

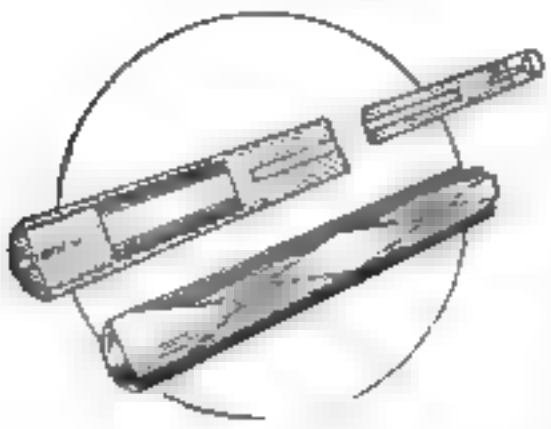
A SHOE-LACE cover with a bow affixed to its upper end has been devised by a New York man who is fond of decorative ankles. The jaunty bow is to please the aesthetic sense while the cover is supposed to save the shoe-lace and keep dirt from entering the shoe. The upper part of the attachment terminates in a buckle and belt device which fits tightly about the ankle.

A Heater for the Parlor Lamp

A LAMP may give both light and heat with the attachment illustrated. It can be applied to an ordinary table lamp, although the construction is applicable to all manners of burners. It can be quickly fitted to a lamp without any structural changes, and it is so simple in construction that anyone can use it. It gives off a maximum amount of heat when applied to any burner.



It Ought to be Light

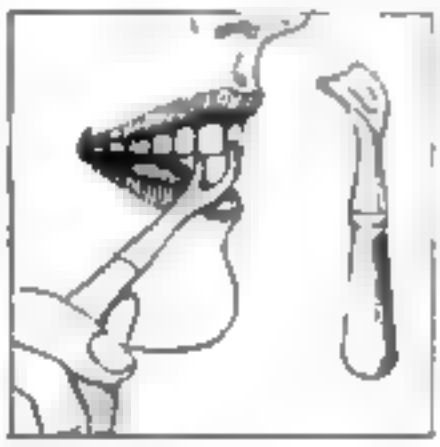


AN aluminum billiard-cue has been devised by a Nebraska man who has long searched for a light cue. His cue is made of aluminum and has a rectangular metal twisted and embedded in the aluminum. It is strengthened by ferrules extending around it which serve to ornament it. The cue is hollow for a portion of its length and is provided with a means for securing the tip rigidly to the striking end.

A Swatter for High Fliers

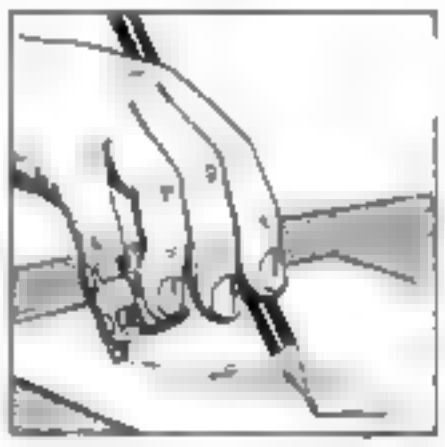
AN adjustable swatter designed for use in killing flies, mosquitoes and other insects on the ceiling of a room or on the walls consists of a spring in a rod which forces the swatter end of the instrument against the insect with sufficient force to kill it. When the knob at the end of the rod is released by the operator the swatter end strikes the wall quickly. The rod is kept in a set position by locking the spring in place. The swatter end may be fastened to the handle with a cord.

Beating the Dentist to It



A TOOTH-cleaning instrument invented by a Kansas City man has a strand threaded and spanning a portion of the instrument for insertion between the teeth to remove foreign matter. The principal object is to provide a sanitary device with a means for holding the strand in proper tension and removing a portion of it after it has been used and substituting a clean portion.

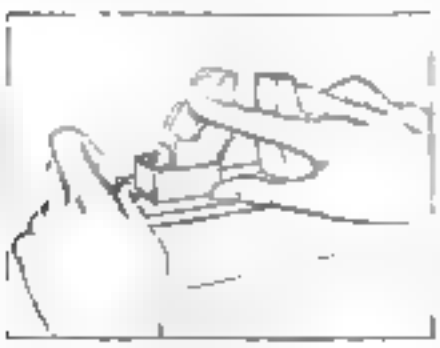
Facilitating Speed in Writing



AN attachment for the hand has been invented which makes fast writing possible. It is a movable rest for the hand which while facilitating the acquirement of speedy writing secures the steadying effect usually imparted by resting one or more fingers on the paper, but without retardation resulting from the latter practice. Frictional contact of the hand is thus obviated and speed increased.

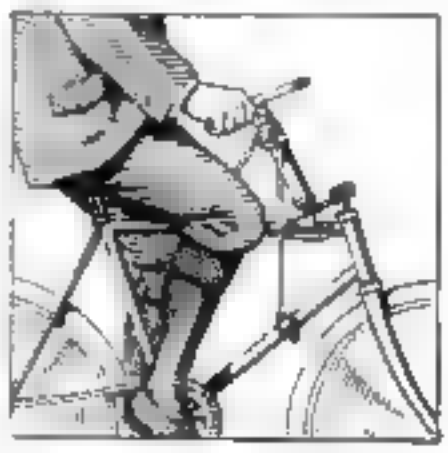
A Cure for Butter Fingers

AN instrument has been invented for music learners and all others (except the pickpocket) whose fingers are stiff and won't behave. It is a finger-spreading device which allows the fingers to be lifted, depressed and exercised in a dozen different ways beneficial to the person learning intricate movements of violin and piano playing. The two blocks of wood are fastened to a wood base by screws which may be tightened or loosened at will.



Automobiling with a Bicycle

THE bicyclist can imagine he's automobiling with a new device which dispenses with the ordinary handlebars and substitutes in lieu thereof a steering wheel which enables the rider to assume an upright and comfortable position and thus obviate injury incident to bending down. The device can be quickly applied to the frame of any ordinary bicycle or motor-cycle to fit riders of varying proportions.



Winners in the Radio Prize Contest

OUR first Prize Contest, which was announced in the April, May and June issues of the POPULAR SCIENCE MONTHLY and which closed on June 15th, brought responses from all over the country.

The first prize, of Twenty-five Dollars in money, has been awarded to Mr. K. B. Warner of Cairo, Ill., for his article on "The Construction of an Amateur's Aerial Mast." This will appear in the September number.

The second prize, Fifteen Dollars in money, was won by Mr. R. H. G. Mathews. His article, entitled "Cures for Trouble in a 200-meter Wave Outfit," will be printed in October.

In accordance with the fourth paragraph of the conditions of the Prize Contest, the Editors have selected and purchased certain other manuscripts. These, to be published in early issues, include the following:

"An Emergency Aerial," by Mr. A. W. Parks, of Sandwich, Mass.

"How to Keep the Telephones from Humming," by Mr. D. Broune, of New York City.

"An Easily Erected Antenna," by Mr. F. M. Meals, of Port Angeles, Washington.

"A Perfected Slider for Tuning Coils," by Mr. Philip E. Edelman, of St. Paul, Minn.

"A Noiseless Tikker Receiver," by Mr. W. A. Parks, of Washington, D. C.

All of these articles describe practical ways in which wireless operators and experimenters overcame their difficulties. It will be worth your while to watch for and read every one of them.

The Editors want more articles of this sort, and will pay for them. Write up how you eliminated your wireless troubles, and so help other amateurs and professionals by sending the manuscripts to us to be printed.

Watch the September number for announcement of our new Radio Service Bureau for readers of the POPULAR SCIENCE MONTHLY. Send us your suggestions and inquiries, so that we can be of immediate assistance to you.

Experimental Electricity

Practical Hints for the Amateur

Wireless Communication

A Wireless Telegraph Transmitter with Two Spark Frequencies

ORDINARILY a radio transmitter using a rotary gap sends out its signals on practically a constant spark frequency, and at the receiving station it is often possible to recognize a number of different sending stations by this characteristic alone. It is entirely feasible, however, to change the group frequency of a spark transmitter. One way of doing this by merely pressing a key or closing a switch is shown in U. S patent 1,175,418 which was issued during the current year to R. A. Fessenden. With a device of this sort the transmitting operator can send messages on approximately half power, by using the lower spark frequency when atmospheric and interference conditions permit. Should it be necessary to signal through strong disturbances on high frequency of spark tone, the full power is immediately available. The method of variable group frequency may also be applied to two-tone sending, by using one rate of sparking to signal dots and the other for dashes. In this plan of telegraphing, the length of impulse for a dash is no longer than that for a dot, and the pitch of tone is the only distinguishing feature. Thus messages may be transmitted at a somewhat higher speed. Since the rotary synchronous gap gives absolutely pure tones of spark, the arrangement of this patent should be especially useful for the two-tone signaling system.

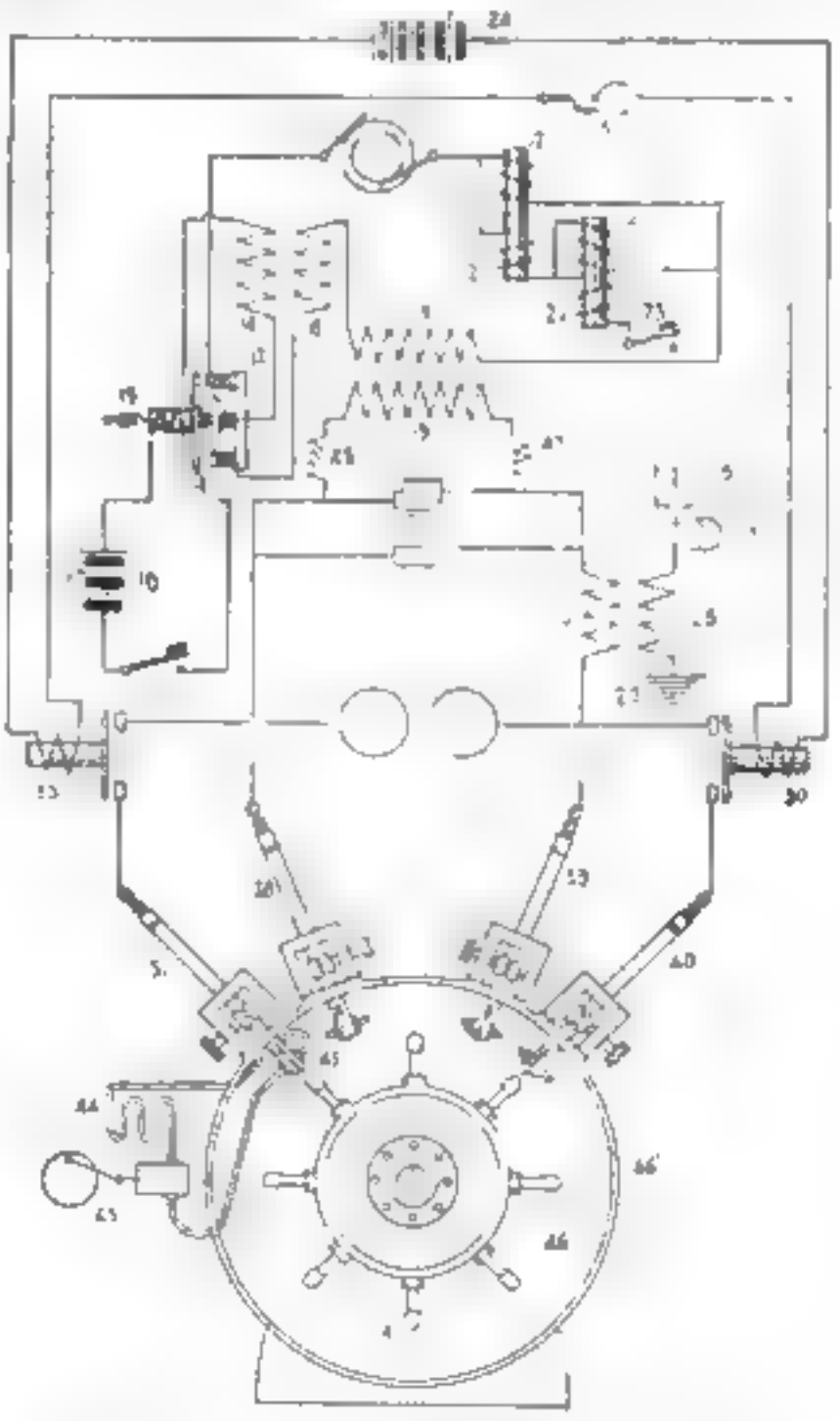
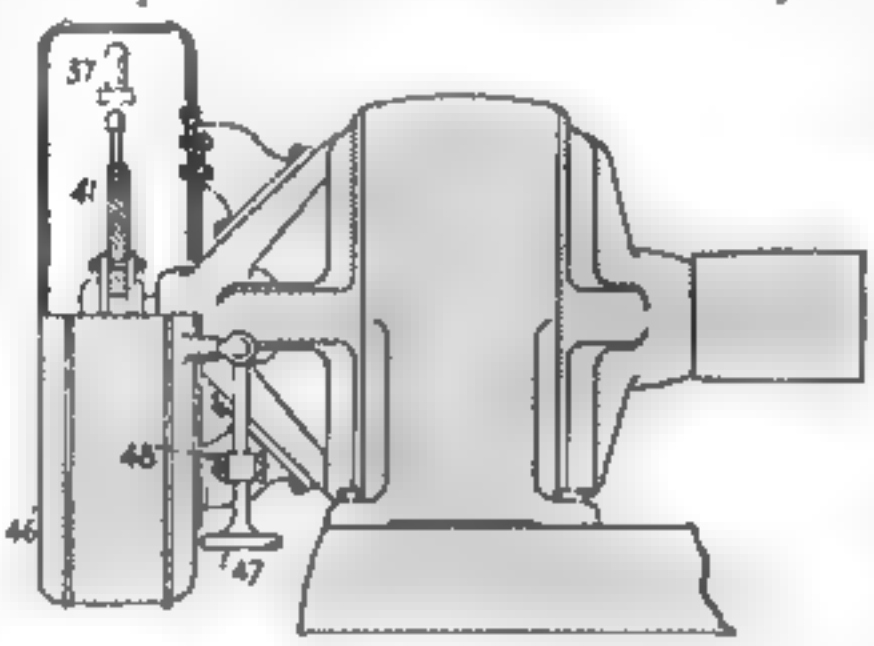


Diagram of the complete transmitter apparatus showing the relations of the various parts to one another

The figure is reproduced from the patent specifica-

tions, and in it is shown a complete transmitter. Power is conveyed from the generator 11, of approximately 500 cycles, to the transformer primary 19 by way of the signaling mechanisms controlled by sending keys 17 and 23. In the first of these a direct current from battery 16 energizes the magnets of relay 12, 13, 14, whose contacts short circuit a portion of the impedance 18, 18^1 (which is shown as a transformer with the secondary arranged to be shunted by the relay) and thus allow the main current to pass. Windings on the relay contact-arm prevent it from opening until the alternating current passes through zero amplitude, and thus sparking is avoided. The alternative method of signaling is by key 23, which in its lower position neutralizes the impedance of coils 21 and 22 by closing a differentially-wound secondary circuit 21^1 22^1 and so provides an unobstructed path for the main primary current.



A radio transmitter suitable for sending messages on half power by using the lower spark frequency

The 500-cycle potential from the secondary of the power transformer 19^1 charges the main condensers 20 through the choke-coils 47, 48. From the condensers the circuit passes through stationary electrode 38, across one spark-gap to the rotor 41 and then back to a second stationary electrode 39. From here the primary oscillations are led through the transformer coil 28 and back to the condenser. The secondary 28^1 is connected to antenna 26 and ground 29 in the usual way, and the ammeter 27 is inductively coupled to the antenna circuit. A protective spark-gap 35 is connected across the main rotary gap, so as to prevent damage from excessive potentials. With connections as outlined, if the rotary gap is provided (as shown) with one spoke for each pair of field poles in the alternator upon whose shaft it is mounted, there will occur only one spark for each complete cycle of alternating current.

If, however, a second pair of stationary electrodes 37 and 40, spaced exactly half-way between the first pair (as regards the electrical cycle), are connected into circuit, there will be a spark for every half-cycle. That is to say, by connecting the additional electrodes into the primary oscillation circuit there are given twice as many opportunites for sparks to pass. The change in connection may be made by moving key 25, which controls the output of battery 24 and thus operates relays 36 and 30. When the key is up the transmitter produces 500 sparks per second, and when it is down, 1,000 per second. Thus the signal tone is changed by a full octave, and by mechanically or electrically linking together 25 and 1 of the signaling keys 17 or 23, dots or dashes may be sent at either pitch of spark-note.

The patent also contains nine other drawings showing details of the spark-gap and stationary electrodes with water cooling (such as is indicated by the pump 45 and circulation system 44), types of oscillation transformers for heavy current, variable loading inductances, high and low potential relays, etc. A transmitter in which the alternator produces a high voltage which may be connected directly across the spark-gap is also illustrated and described.

A Booth for Long Distance Receiving

TROUBLE is sometimes experienced in receiving the faint wireless signals during rainy weather, on account of the noise caused by the rain pounding on the roof of the wireless room.

This trouble can be overcome by building a small double-walled booth, similar to a telephone booth, within the room in which the outfit is placed. Sawdust should be packed between the walls and ventilation provided by means of two tubes, one in the top and the other near the bottom.

How a Compact Molded Condenser Is Built

U. S. PATENT No. 1,174,600, issued to W. J. Murdock, shows the construction of the molded condensers which have become familiar in wireless telegraph sending stations. By first fixing in position the plates of the condenser and then casting them solidly into a mixture of pulverized mica and resinous gum, the inventor states that he secures a condenser which is compact, strong, efficient and inexpensive. The drawings show how the two sets of plates a, a, a, and b, b, b, are connected to the terminals e and g by means of the strips d and f. The terminal screws pass through conducting strips h, i, which have their adjacent ends beveled and form a protective spark-gap n. The molded dielectric material, c, is uniform throughout and there are no insertions of mica sheets or other separators. Units of convenient capacity and voltage may be made up and combined in series or parallel to meet the needs of any particular transmitting outfit. The condenser has found extended application in portable small-powered quenched-gap senders.

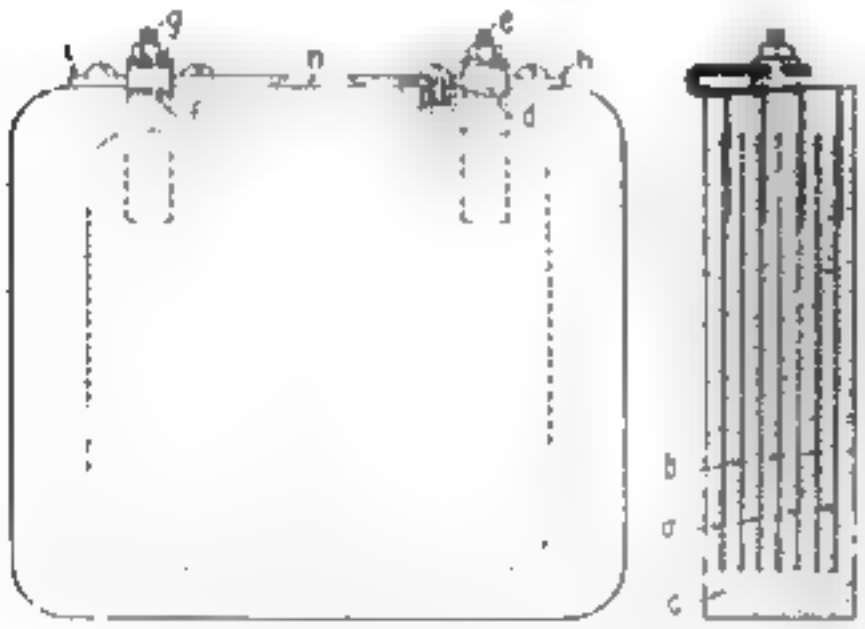


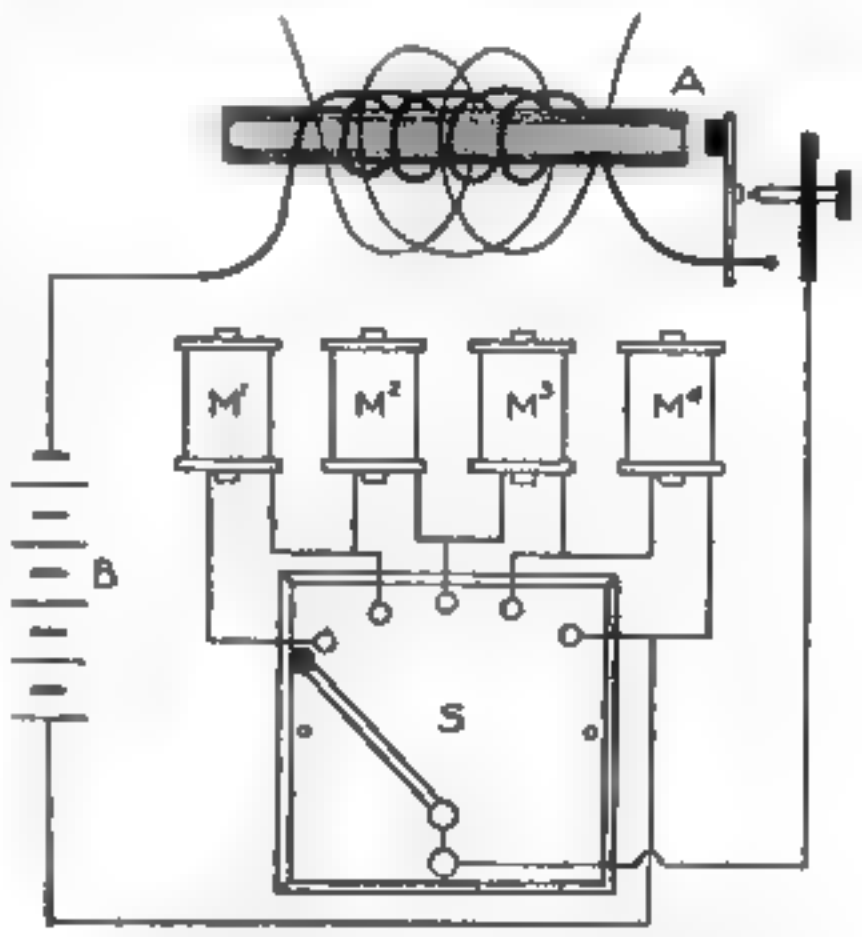
Diagram of a molded condenser for small quenched-gap senders

Small Radio Stations

THERE are in the United States three licensed amateur stations using only five watts inpud power in their transmitters. Several others use six, eight and twelve watts. It requires about fifty watts to light an ordinary carbon-filament sixteen-candlepower electric lamp

Primary Regulator for the Induction Coil

The induction coil is shown by *A*. *B* represents the battery, and *S* a five-point switch. *M*-1, *M*-2, *M*-3 and *M*-4 are magnets from old electric bells. By switching in one or more of these the power used by the coil can be reduced as desired.—C. S. PORTER.



An arrangement for regulating the power used by an induction coil

Cardboard Tubes

A GREAT many amateurs, when making tuners or loose couplers, are puzzled when they come to the cardboard tube problem. They either do not know where to buy the tubes, or cannot make them successfully. However, these tubes can be easily made.

The first thing to do is to get a round cylinder the desired length and diameter and some thin cardboard or thick paper. Wind the paper or cardboard around the cylinder. After the first layer has been put on coat the inside of the paper with glue to make the layers stick together. After the paper has been wound on to ⅛ or 3/16 in. thickness, put elastic bands around the tube to hold it from becoming loose. After the tube has become thoroughly dry take it off the cylinder and coat it with shellac. This process serves to strengthen it appreciably and makes it ready for use.—ALBERT KILLMEYER.

A Home-Made Edison Battery

THE good points of the Edison battery are great constancy, very low internal resistance and freedom from local action when on open-circuit. Following are the particulars of a home-made Edison battery which can be built very cheaply and which will give every satisfaction.

The battery consists of a perforated copper pipe *A* (Fig. 1), containing black oxide of copper as the positive element, and a zinc cylinder *C* as the negative element.

The exciting liquid is a 25-per cent solution of caustic potash in water, which means a solution of one pound of caustic potash to three pounds of water. The containing jar is represented by *D*; *E* is a cover which excludes dust and from which the copper pipe and zinc cylinder are suspended by means of the brackets *F* and *G*. The two binding posts *H* are connected to *A* and *C* respectively.

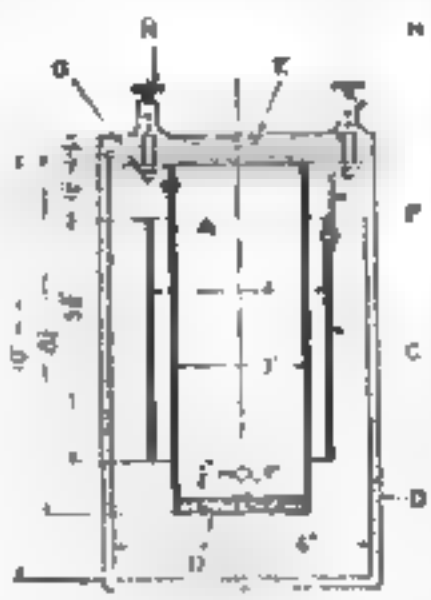


Fig. 1. Dimensions and parts of the battery

The battery here described, which will give a constant current of 20 amperes, uses a containing-jar 6 ins. by 10 ins. In building this battery it will be best to obtain the containing jars first, since all the other dimensions are fixed by the size of the jar.

Fig. 2. Proper position of the lugs on the cylinders

First procure a copper tube of 3-in. bore and 8¼ ins. long, about 1/32 in. thick. To perforate the tube, slip it over a stick of wood a little smaller in diameter than the tube; punch the holes through with a punch or a nail. The holes should be about ⅛ in. in diameter.

Cut a wooden disk 3 ins. in diameter and about ⅜ in. thick. Drill a ¼-in. drain-hole in it and soak it for about fifteen minutes in molten paraffin wax. Then fix the disk with shellac solution in the bottom end of the copper tube.

Procure some copper strip about 1 in. by ⅛ in. Bend 3 lugs, *G*, as shown, and rivet them to the copper cylinder. The lugs must be equally spaced (Fig. 2), showing the drilling in the top cover *E*, where *X* represents the holes for supporting *A*, and *Y* the holes for supporting *C*.

The copper cylinder is now completed and we take next the zinc cylinder in hand. This should be made from rolled zinc and not from cast material. The best plan is to buy a cylinder of the size required as you are sure to get the right material. Preferably the zinc should be well amalgamated as it lasts much longer. Three lugs made from the same strip as used for the copper cylinder should then be riveted to the zinc cylinder. They must be again equally spaced as shown in Fig. 2.

One lug on each copper and zinc cylinder should then be soldered to the respective cylinder in addition to the riveting, so as to make as good a connection as possible. These two lugs are the ones subsequently connected with the binding posts *H*.

The cover *E* is now the last part to be made. It is made from good hardwood to the dimensions given and should be a snug fit in the containing jar. Six holes ¼ in. in diameter are then drilled in the cover and spaced as shown in the figure, so as to avoid a short-circuit between the lugs *G* of the copper cylinder and the lugs *F* of the zinc cylinder.

The cover must now be soaked in molten paraffin wax for at least fifteen minutes. Then obtain two large binding posts *H*, ten 3/16-in. nuts, 6 washers for the same and 6 steel rods, screwed 3/16 in. on each end, one end to take the binding posts or nut on top of the cover *E* and the other end to take the nut below the brackets *F* and *G*.

In assembling the battery, first fill the copper cylinder with black oxide of copper and bolt the cylinder to the cover *E*. Fix the zinc cylinder *C* to the

cover and fill the containing jar to about 1 in. from the top with a 25-per cent solution of caustic potash in water. On top of this solution pour a layer of heavy paraffin oil about ½ in. deep to exclude the air and prevent creeping.

The battery is now ready for use and needs no attention whatever till it is exhausted and all the oxide of copper reduced to metallic copper. This is of great purity and is worth a good price.

The 25-per cent solution of caustic potash is best made up in the following way:

First ascertain how much water the container will hold when the filled copper cylinder and zinc cylinder are in place. Pour off about a third of the solution and put in the amount of caustic potash required. Stir very gently, since a drop of that solution in your eye might cost you your eyesight.

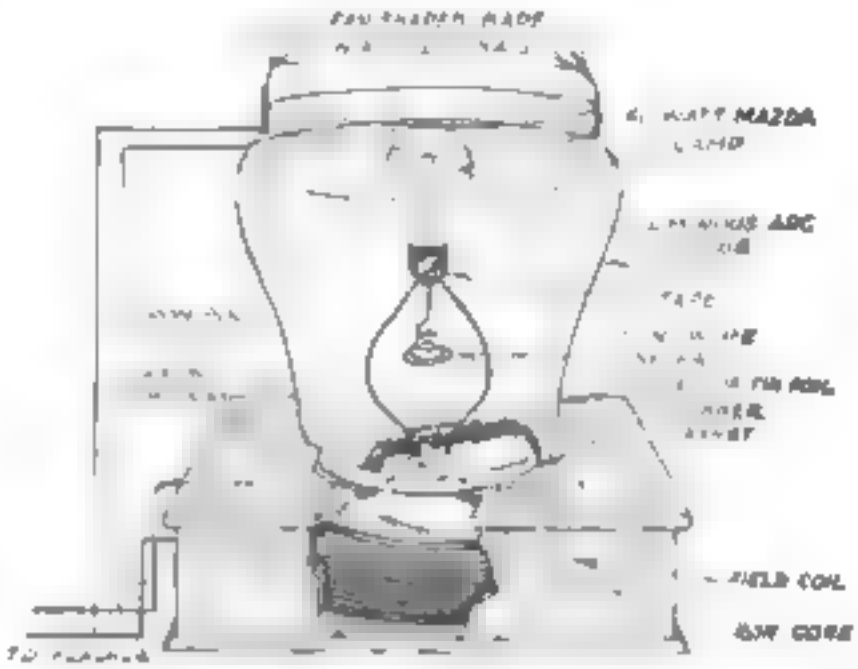
A Clever Window-Display

A MYSTERIOUS window-display which attracts passersby and holds their attention consists of an opal ark-lamp globe practically full of water in which an incadescent lamp floats tip up. At short intervals the lamp lights up brilliantly and at the same time submerges itself in a very mysterious way. After a few seconds it bobs up and its light practically fades out. This cycle is continued indefinitely. The only explanation for the odd movements of the lamp seems to be some bared wire ends projecting over the edge of the globe, giving the idea that it is regulated in its movements by wireless influence.

The true explanation of the device is as follows:

A field coil from an old dismantled motor was placed in a box and within was put an iron core. A small iron pulley was actually used for this. An iron bolt was put through the box cover into the center of the core and the wires for feeding the lamp run through the cover alongside the bolt. The lamp was connected in series with the coil, the wires were soldered to the lamp base and well protected by rubber tape. To seal the bottom of the globe it was put on a rubber sheet and a layer of sealing compound filled in; an electric soldering iron was used to work the compound well around the edge and about the bolt head to make a water-tight seal.

Fastened to the lamp base by a loop over the tape was an iron wire with the lower part arranged in spiral form; this was of just the right weight to keep the lamp about half submerged when the current was off. Connected into the circuit was a Thermoblink flasher which periodically cut the current in the lamp and coil circuit down to a low value. As the current was restored to full value,



The mysterious electric lamp which glows brilliantly one moment and the next fades away beneath the water

the coil was energized and the iron spiral with the lamp was pulled down toward the bolt head, a sheet of tinfoil over the latter preventing actual magnetic contact and sticking due to residual magnetism when the current was again cut down to its low value.

The box on which the globe was placed and the wires really leading to the coil and lamp were covered by a cloth, leaving very conspicuous, however, the wires on the outside of the globe to the antenna-like ends.

Lowering the Decrement

THE present radio laws require that every transmitting station shall emit "sharply tuned" waves. The logarithmic decrement must be less than 0.2. The smaller this decrement the more waves in each wave-train and the sharper the tuning. With a decrement of 0.2, which is really quite high, there are only 12½ waves in a wave-train before the amplitude has fallen off nine-tenths.

Music by Wireless

UNITED STATES Patent 1,166,582, issued in 1916 to G. Desilets, shows an interesting "Wireless Apparatus for Producing and Transmitting Musical Sounds." By the use of this method, which is here shown diagrammatically, it is possible to play tunes the same as on a piano, and to have the music thus played transmitted by wireless to a distant station and there reproduced. It is seen that alternating current power lines are led to the primary of transformer 43 by way of the special piano-keyboard switches shown at 22. All of these are connected in parallel, and closing any of them serves to apply power to the transformer. The secondary charges condenser 47, which discharges with oscillations through the primary portion of helix 46 and whichever of the rotary spark gaps 3 to 10 is connected by the high-voltage switches of keyboard 22. It may be noted that in the drawing of the patent itself the condenser and spark gap are incorrectly connected to the helix and transformer; from the specification it is obvious, however, that the wiring shown was intended.

The novel points of the system are in the rotary gaps 3 to 10 and in the keyboard 22. Each of the gaps has a different number of spokes, and the numbers are chosen so that the spark frequencies correspond to the notes of an octave in the musical scale. Thus if key 23 is pressed, disc 3 is connected; if this disc has 10 spokes and if the shaft revolves about 1500 r.p.m., 250 sparks per second will be produced. Since the spokes are evenly spaced, the sparks will occur regularly, and a musical note of about middle C on the musical scale will be produced. If key 30 were pressed, double the number of sparks would occur per second, and the musical tone would be one octave higher. Similarly the other keys connect the other gaps, which have their spark frequencies properly chosen so as to give the various notes of the scale. When more than one octave is desired additional gaps are made use of; instead of increasing the number of spokes indefinitely the inventor prefers to duplicate the octave of gaps but to rotate the next higher group at double speed. This of course doubles the spark frequency and therefore doubles the pitch. By supplying sufficient power it is feasible to play chords by pressing several of the keys at the same time. The loudness of the musical tone can be regulated by rheostats operated by pedals and connected so as to vary the intensity of the sparks. It is easily seen that the radiation from a transmitter of this sort would produce musical tone effects in any receiver, using a telephone in combination with any of the usual rectifying detectors.

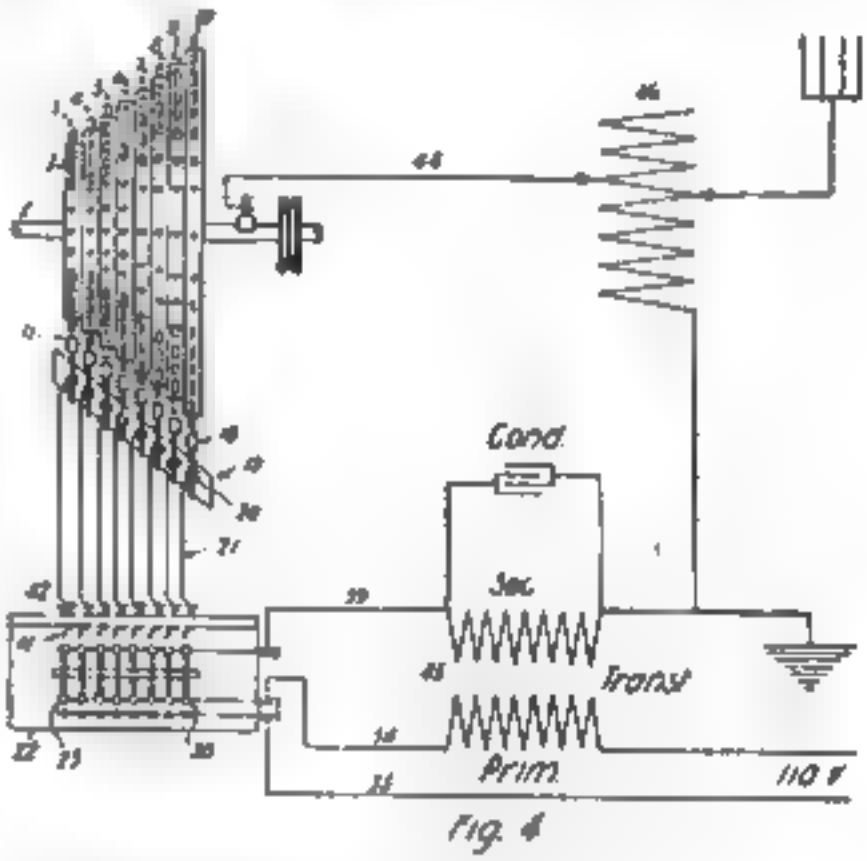


Fig. 4

Music may be transmitted by means of this wireless apparatus

Lighting Audion Bulbs Cheaply

AMATEURS who are not fortunate enough to possess a storage battery often light their audions by the current from dry cells. When the detector is used for any length of time, however, the expense of this method is almost prohibitive. The following is suggested as an exceedingly inexpensive substitute, which may be used by those who can secure worn-out dry cells:

Cut the tops from five one-quart jars or bottles, and fill them one-third to one-half full with a saturated solution of sal-ammoniac. Next scrape all the shellac from the zinc of five old dry cells, and punch 1-8 inch holes about an inch apart all over the shell. When these cells are placed in the prepared solution they will light the bulb nearly as long as a new battery, and at an expense of possibly two cents for the chemical.

Five Examples of Alarm Work

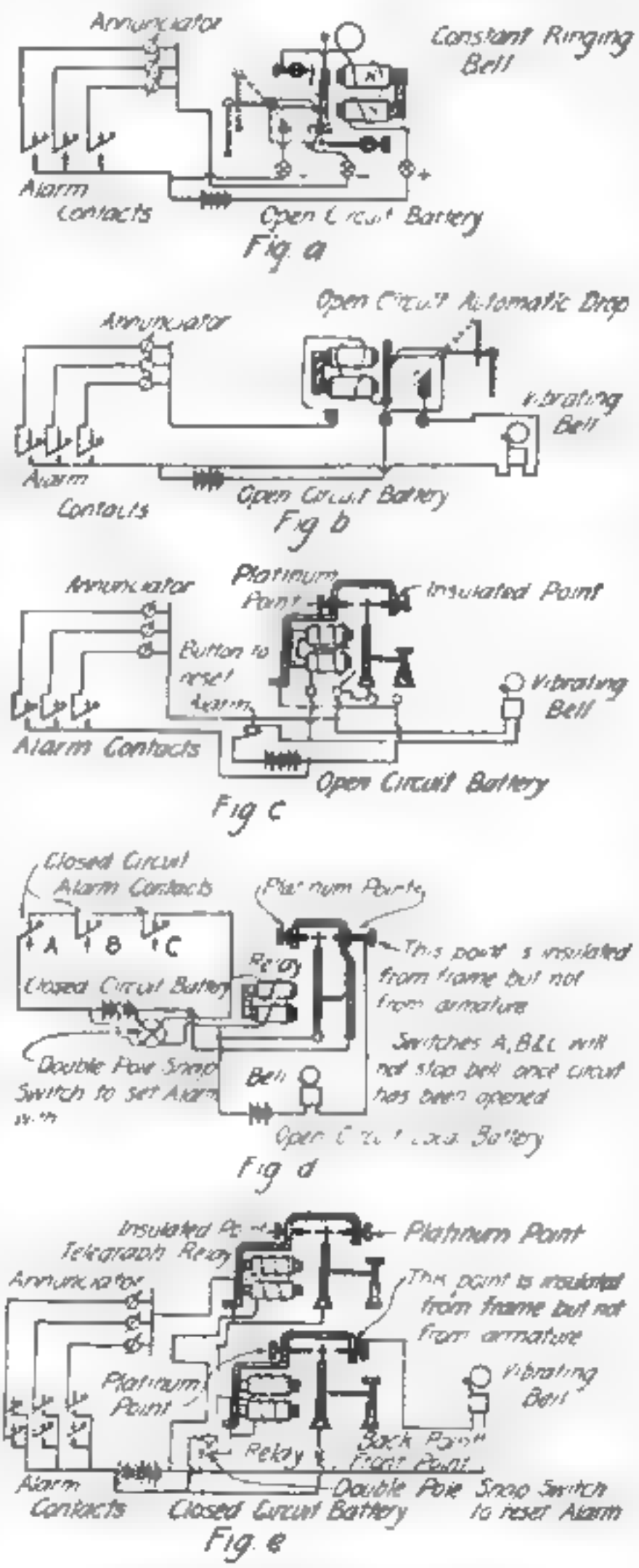
THIS may be done by arranging the circuits as shown in Figs. a, b, c, d, e. Usually when it is necessary to employ a constant ringing method on a call system, an annunciator is also installed and a point provided on the annunciator for each place where a call is turned in. This is shown in all of the diagrams.

In Fig. (a), a constant ringing bell is used. This type of bell is a combination of the vibrating bell and the automatic drop. Its operation is as follows: the circuit is taken through the push-button and a point on the annunciator, then through the coils in the bell and back through the battery. This causes the armature to be drawn in and allows the drop to fall, completing another circuit through the bell, the connection being from line to bell to line. This will cause the bell to ring as long as there is enough current in the battery.

In Fig. (b) practically the same operation takes place except that the bell and the drop are separate.

In Fig. (c) the diagram is based on another principle. When the push-button is closed, current flows through the coil of the relay. The bell is parallel with the relay. This will cause the armature to be drawn up, closing the circuit through the armature of the relay and the frame. This will close a circuit through the coils on the relay and the bell continually. As there is a circuit through the coils the armature will be drawn up and held there as long as the current flows.

In Fig. (d) is illustrated a closed-circuit alarm. To be adapted to a call system it must be connected as shown in Fig. (e). The current flows through the contacts and the coils of the relay to the armature of the relay to the frame of the relay and back to the battery. The platinum point of the relay is toward the coils and the armature must be drawn over toward the coils before the circuit is complete. Once completed it will be held by the action of the armature. A switch is provided for closing the circuit. The bell is connected across another battery, although it could be connected through the same one. The current for the bell passes through the armature of the relay and the extra platinum point on the relay which is insulated from the frame. As the circuit through the contacts is broken, the spring will pull the armature away from the contact point toward the coil and against the contact point to which the bell is connected.

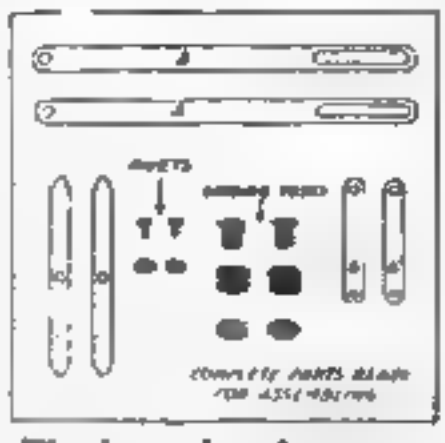


Wiring diagrams of a five-bell electric annunciator system

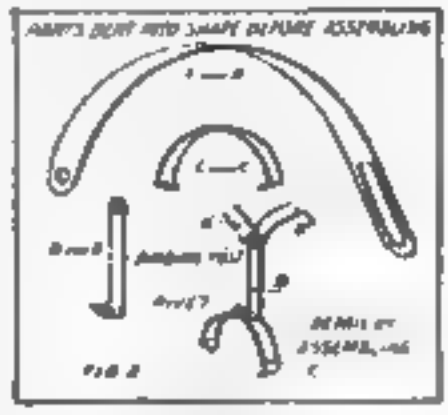
Telephone Headbands

THE accompanying drawings show a simple but very substantial pair of wireless headbands. All the materials needed are six pieces of spring brass (they may all be of the same thickness), two binding posts, four washers and two rivets.

Procure about 40 ins. of strip brass, 3/64 in. to 1/16 in. thick and about ⅝ in. wide. Out of this cut two pieces 12½ ins. long. Round all ends and in one end of each drill a hole 3/16 in. in diameter. In the other two ends cut a slot 2½ ins. long and ¼ in. wide. This is done by drilling a series of holes with a ¼-in. bit as close to each other as possible, the entire length of the slot. The "tooth" edges remaining may be filed away or cut away with a cold chisel and then filed smooth. Do this carefully as a neat slot adds much to the appearance of the headbands. Now bend both pieces in the shape shown in Fig. 2, and these pieces are finished.



The brass bands, rivets and bolts needed to make the headbands



How the metal strips are bent and riveted together in assembling

Next cut two pieces of the same material 1¾ ins. long and round the ends. Drill a hole 3/16 in. in diameter in both ends and bend one back at right angles, 5/16 in. from the extremity (see Fig. 2).

Now cut two more pieces 4¾ ins. long. These should then be cut to ⅜ in. wide. In the center of each piece drill a hole 3/16 in. in diameter. File or cut the ends to the pointed shape as indicated at *C*, Fig. 2, and bend the pieces as shown.

All cutting is now finished and the pieces are ready for assembling according to Fig. 2.

Secure two binding posts as much like those illustrated as possible. Put one of these through the hole in the straight end of *B* so that it points in the same direction as the small leg of *B*. Now put on piece *A* by slipping the end with the drilled hole over the binding post on top of *B*. Next put A^1, in the same manner, on top of *A*, and then add a washer and screw the top of the binding post on tightly. Do the same with piece B^1 and the slotted ends of *A* and A^1 only slipping the binding post through the slots about ½ in. from the end.

Take a small rivet and put it in the hole in the other end of *B* and then through the hole in *C* so that *C* is underneath. Slip a washer over the free end of the rivet and flatten with a hammer. Do not make it too tight as *C* should turn freely. Do the same with the bent end of B^1 and piece C^1.

Adjustment is made at the binding posts for widening the bands; at the slots for shortening them and the 'phones swivel at the rivets. Polish the brass or have it nickel-plated. A good-looking, well-working pair of headbands is the result of about one hour and thirty minutes' work and an expenditure of twenty-five cents.—CHAS. T. WANDRUS

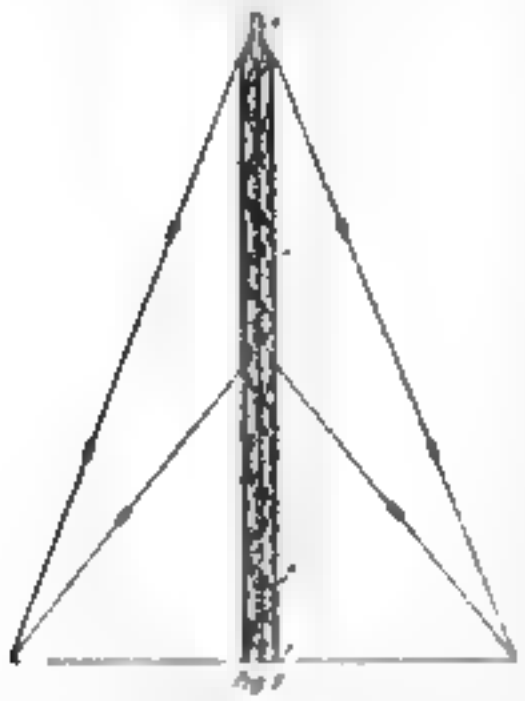
A Substitute for an Aerial

IT often happens that the amateur wireless experimenter finds his aerial is too small to be efficient on long waves, although it may be all right for short waves. It is sometimes impossible to erect an aerial suitable for long waves. It has been found that by connecting rain pipes to the receiving set with a single wire lead-in, a fairly good aerial is had for waves over a thousand meters. Arlington, about 1400 miles distant, came faintly on a regular 100-foot aerial using loose-coupler and loading coil, while using the rain pipes that station was heard sharp and clear with a little over half of the primary of the loose-coupler in circuit. The lead-in should be connected to the pipe nearest the instruments. This scheme may not work every time, but if the amateur has access to a system of ungrounded rain pipes it may pay him to try. Where the amateur can not utilize rain pipes the ordinary lightning rod, if it is installed correctly and is not broken in its entire length, will serve as an aerial in place of the more convenient rain pipes.

A Built-Up Wireless Mast

THE following article tells how anyone possessing ordinary working tools, can easily, quickly and inexpensively construct a mast of a distinctly modern type not usually found at amateur stations. Since it is built of wood, the mast is light and easy to erect. It can be readily used in close quarters, since it requires few guys, and consequently it can be placed quite close to a fence, building or wall.

The material should all be clean, straight, white pine, since this wood will withstand severe weather. All the strips are 1 in. by 2 ins. in cross-section, and may be bought at any lumber yard. The prices range from 1 to 3 cents per lineal foot.



Note how the mast is built up in sections

The mast should be built on a perfectly flat place, such as a large floor or level concrete sidewalk. First, three pieces of the material about 1 in. long are sawed off and nailed on the floor to form an equilateral triangle measuring 24 ins. on a side, as shown at *A* Fig. 2. Next cut off 39 pieces, each 24 ins. long, for the cross-pieces *B*, *C*, *D*, shown in Fig. 2. The ends of these pieces are notched to fit in the triangle formed by the pieces *A*, as shown in Fig. 3. Each cross-member should be fitted, and when three are finished, they should be marked as one set and put aside. In this manner 13 sets are made.

When these cross-members are all done, start work on the uprights. Each upright should be 47 ft. long and made by joining several strips by means of scarf joints at least 6 ins. long, using No. 14 wire brads 3 ins. long.

Having completed the uprights, the cross-members may be put in. The first set is 1 foot from the bottom, and the remainder are 4 ft. apart. The last section, *F* in Fig. 1, will be 2 ft. long in the 50-foot mast. Next put in the braces from corner to corner, having them tight and butting against the cross-members. They must be firmly nailed in place, both to cross-members and uprights. The ends are to be chamfered off to fit the corners, as shown in Fig. 4.

The main part of the mast is now finished, and the pole may be put on top. This is a piece, preferably of oak, 2 ins. by 2 ins. and 18 ins. long. The top is chamfered off to shed water and the bottom made triangular in shape, so as to fit the step on the top of the mast, as shown in Fig. 6. The three pieces, *P*, *P*, *P*, are of the same material as the mast, and are fastened on the bottom side of the top cross-member, set by means of screws, as shown. The six-sided piece *F* is fastened under the three pieces *P*, *P*, *P*, and acts as a bottom for the step. The mast is braced by three pieces shown at *G* in Fig. 1. These rest on the ends of the

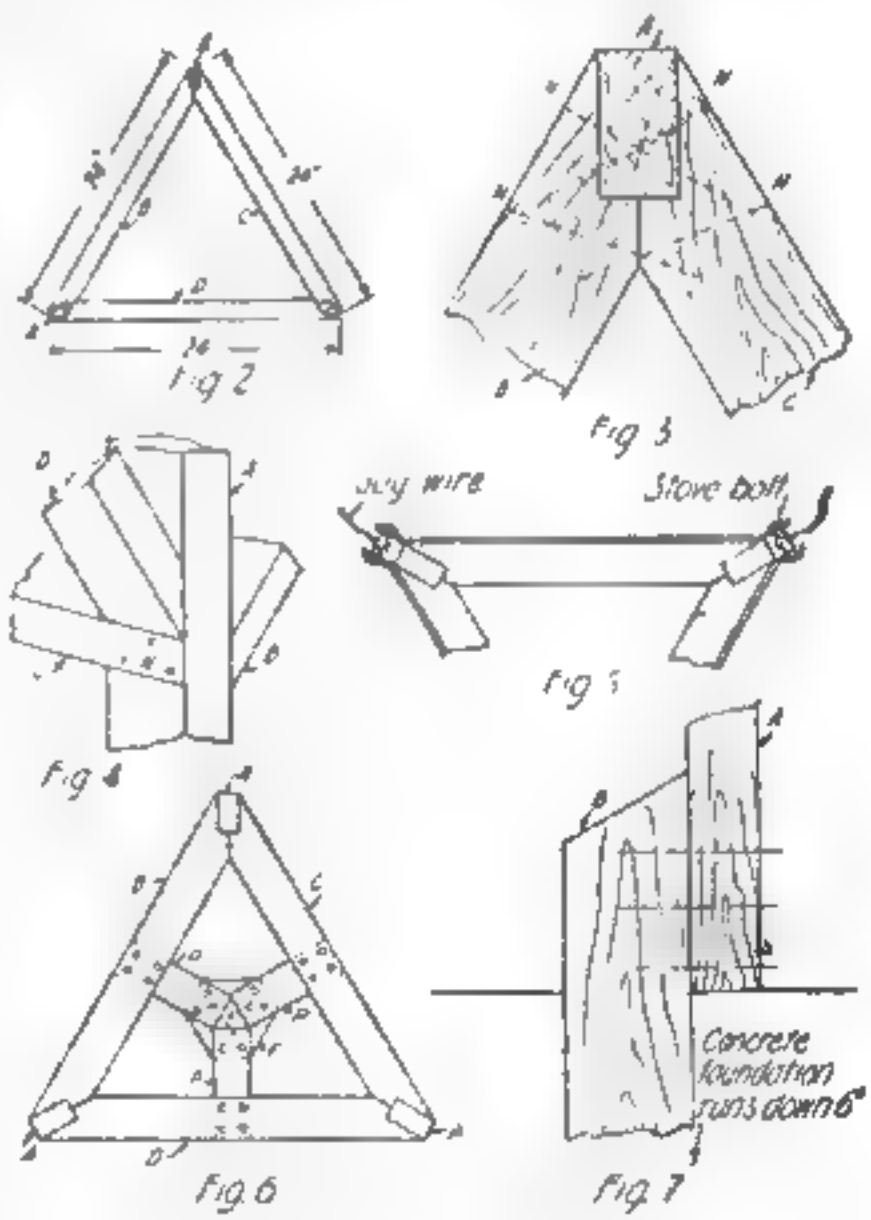


Diagram showing the construction of the built-up wireless mast

uprights *A*, *A*, *A*, and are firmly toe-nailed to them. They are further strengthened by three pieces of iron, each 6 ins. long, and 1 in. by 8 ins. These are bent to fit the angle of the outside of the uprights and the piece *G*, and are then fastened by screws to both

More iron of the same size is used to make the guy-wire hooks, as shown in Fig 5. Six are required to be fastened to the cross-wires as indicated. Carriage bolts are inserted through holes drilled in the ends, and the wires are attached to these bolts. Obviously, the guy-wires are attached before raising the mast, and may be broken up by insulators as usual. No. 10 or 12 galvanized iron wire is good for the guy-wires, the lower ends of which should be fastened to heavy stakes, trees or "dead men." A good anchor is made by burying about 3 ft. of telephone pole, with a stout wire fastened around it, some 3 or 4 feet deep (crosswise or horizontally). The guy-wires may be fastened as close as 20 ft. to the base of the mast, but should be farther away if space and conditions permit.

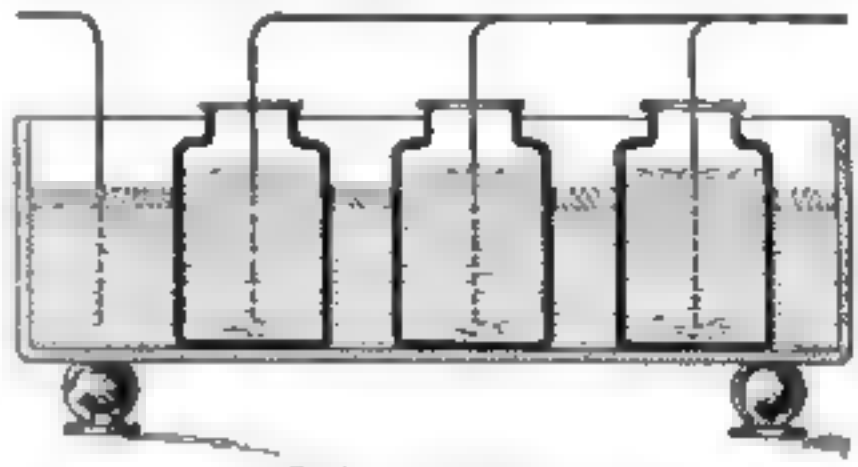
Since the mast is rather light, a heavy foundation is not necessary. A good foundation can be made by digging a hole somewhat larger than the mast and about 2 ft. deep, and filling it with a cinder or stone-concrete mixture, leveled off on top. Three pieces of pine, 3 ins. by 3 ins. and about 1 foot long, should be embedded in the concrete about 6 ins., forming a triangle the size of the inside of the base. When the mast is set over these, the three uprights may be nailed to them as shown in Fig. 7, thus keeping the foot of the mast on the foundation.

A pulley should be attached to the top of the mast by means of an eye-bolt through the pole. A good half-inch manila rope is best for the halyard. The rope should be twice as long as the mast and spliced to prevent its pulling out at the top. This pole is very stiff, if carefully constructed, and may be picked up by the extreme ends without bending. In raising, there should be a man at each guy-wire to keep the mast straight. If it is to be near a building, a block-and-tackle may be rigged up on the side of the building and the mast raised by hauling on the top or middle. If no such conditions exist, it may be pushed up with poles in the way a telephone pole is handled. Painting, preferably with whitelead, should, of course, be completed before erecting.

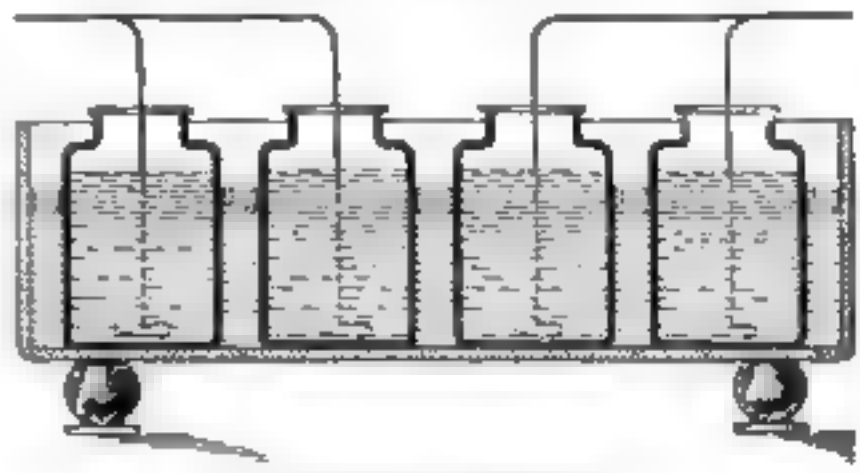
The builder will find the mast much easier to construct, once he gets started, than he may at first imagine. The first mast of this type ever built has been up for some time, and has weathered several hard windstorms, in spite of the fact that the two guy-wires which carry the strain are in a line that is not more than 12 ft. from the base.—C. S. ROBINSON.

A Sending Condenser

A GREAT many amateurs try to use glass fruit jars of brine in a tank or pan of brine but after a trial give up this scheme because of the brush discharge and the bother of frequently having to replenish the water. If enough automobile lubricating oil is poured in to make a layer of about one-half inch on top of the salt solution, the evaporation and most of the brush discharge will be stopped. The inside brine acts as the inner coating of a Leyden jar, and the salt water in which the jars stand takes the place of the outer coating. The drawing shows how to connect for high or low voltage.



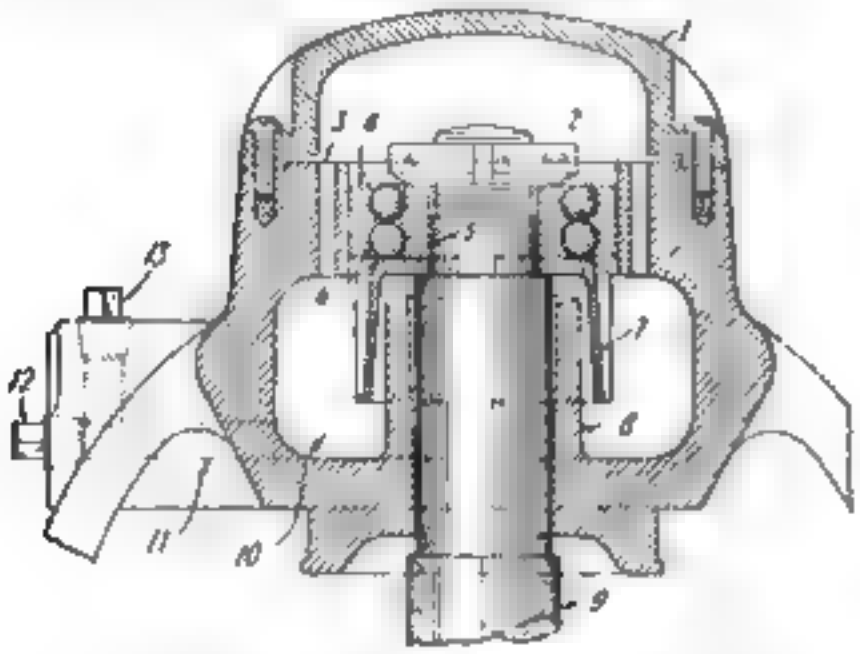
Series connection



Parallel connection

Rectifying Alternating Current

A NEW machine designed to rectify alternating current at li ' voltage into direct current at arc voltage has been placed on the market. It involves a radical departure from all former prac-



Ingenious machine changes alternating current into direct current without perceptibly decreasing the light

tice in motor generator sets, as applied to motion picture projection. The armature sets in vertical position, or stands on end, and is carried or supported on ball bearings. The direct current generator is of the inter-pole type, there being four inter-poles and four main poles. The inter-pole feature is an important one since it makes possible the handling of heavy fluctuations in current without sparking at the brush, or with sparking reduced to a minimum. It acts as an aid to commutation, and at the same time produces a constant current characteristic which is most desirable for projection work.

In order to reduce vibration and noise the vertical type of construction is used. The ball bearings greatly reduce the friction load, which partly accounts for the high efficiency. In order to secure a perfect armature balance the manufacturers test each machine in a dynamic balance at a speed of seven thousand revolutions a minute, which is approximately four times full load speed. The forced ventilation produced by the fan between the motor and the armature keeps the machine cool

One of the important features of the equipment is the ability to dissolve from one lamp to the other without a perceptible decrease in the light. The machine is so arranged that the operator can change from one lamp to the other before it is possible to heat up the carbons of one lamp with say, fifteen amperes, while operating the other lamp at fifty amperes. While the machine is only rated for constant duty as a fifty ampere equipment, yet it is designed to stand eighty amperes during the change, providing that change does not occupy more than five minutes.

The construction of the upper bearing is shown in the accompanying illustration, in which 4 and 5 form the inner and outer shell of the ball-race carrying-balls 6. The inner race 5 is locked to armature shaft 9 by nut 2 and revolves therewith. The outer race 4 sets in a recess in the main frame casting and is stationary. Ten is an oil-well, and 7 is an oil-thrower, which is locked to the shoulder of shaft 9 under inner ball race 5 by nut 2, and revolves at armature speed. The action is that the oil is, by centrifugal force, thrown up through passage 3, whence it descends through and around balls 6 by gravity, thus flooding the entire bearing with a constant stream of oil. Thirteen is the plug which closes the upper end of passage 11 through which oil-well 10 is filled. Twelve is a plug through which oil-well 10 may be drained and washed out with kerosene.

From ink-bottle top to insulator

Adjusting Handles

THE composition tops of drawing-ink bottles may be conveniently used for insulated handles for many instruments by drilling a hole in the center and inserting a brass screw. These look like hard rubber and are very serviceable. Under constant use they will wear as well as most insulators now in use and when broken can be thrown away as useless.

Making an Electric Fire Alarm

A SYSTEM of fire warning illustrated herewith may be installed at little expense. The installation makes use of mercury, and it can be quickly adjusted and requires no resetting. The detecting mechanism is clearly shown in Fig. 1. It consists first of a glass tube *A* about 2 ins. long and having a bore of 1/8 in. or a trifle more. A short piece of brass rod that just fits the tube has a piece of copper wire soldered to it 4 ins. long. The rod is fitted into the tube as shown at *B* and the end of the tube is filled with sealing wax *C*. The rod should not fit too tight or its expansion will break the tube.

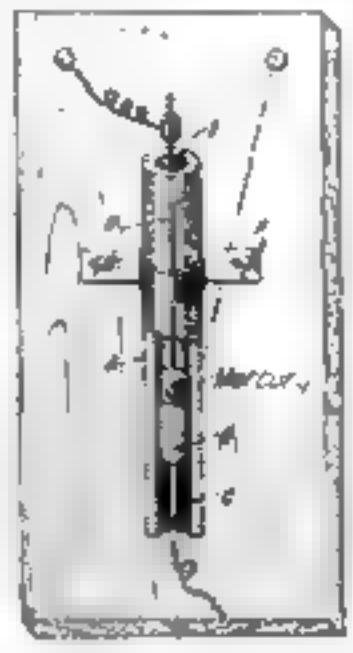


Fig. 1. The fire detecting mechanism complete

A small rubber cork that fits the tube tightly has a needle run through it. A short length of wire should be soldered to this needle as shown in the drawing. The tube is fastened to a base measuring 1½ ins. by 3 ins. by means of a brass strip *F* and two small screws. Binding posts are mounted on the base and the wires connected to same.

A few drops of mercury are put in the tube and the rubber cork and needle inserted as shown at *D* and *E*. By regulating the distance between the needle and the surface of the mercury the temperature at which the alarm is given can be regulated.

A good method of adjusting this apparatus is to connect a bell and battery to the terminals. Place the instrument and a thermometer in an oven or sand bath and adjust the needle so the bell just rings when the thermometer registers 110 degrees F.

In Fig. 2 is given three wiring diagrams that may be used with this apparatus. At *A* is shown the fire detectors connected in with the regular burglar alarm system which is the easiest way of installing the apparatus. At *B* a third wire is run and two bells are used so that the householder can determine whether it is a fire or burglar alarm. The bells should give a different note and this can be done by placing a wad of paper under one or by sawing a slot. The third diagram *C* shows the instruments connected for fire alarm only.

An added feature refinement would be an indicator to show at a glance where the alarm is coming from. Note particularly the three-point switch in diagram *C* which enables the owner to test the bell and batteries by placing it on point 1. Placing it on point 2 puts the system into service and point 3 can be used as a ground test for the wiring.

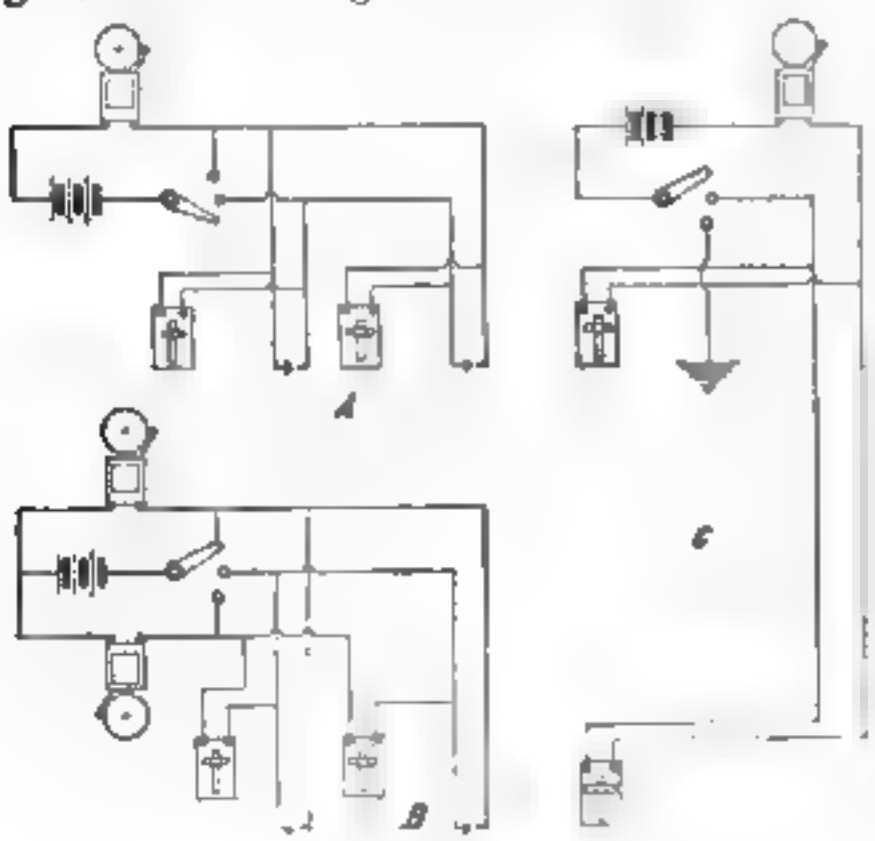


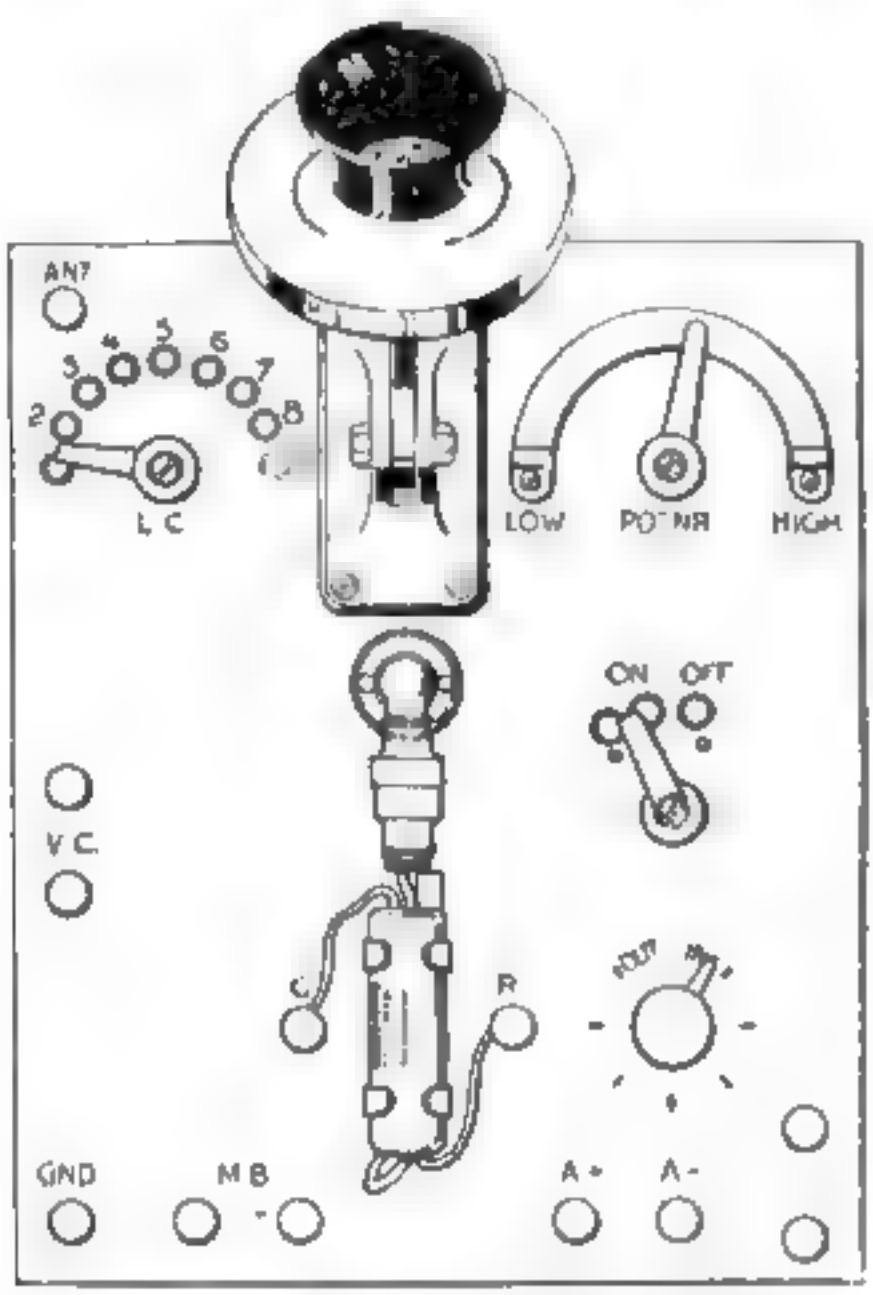
Fig. 2. Three methods of wiring which can be used with this apparatus

A New Detector Material

SINCE the mineral type of detector was first discovered, attempts have been made to use artificial substances in place of the natural minerals, but as a rule these preparations are much less sensitive. A European inventor claims to have found a mixture that produces a very good substitute for mineral, and which is quite as sensitive. Besides, the effect is claimed to be uniform all over the surface. To make this, mix two parts of pulverized galena with one part of natural mineral silver in the shape of filings, then add stibine and sulphide of silver. When an intimate mixture has been obtained, put into a test tube and heat to white heat. Temper while hot in ammonia water and remove the compact mass, which may then be mounted for the detector in the same way as a piece of mineral.

Modified Audion is New Telephone

THE newest oscillation generator to be used in radio telephony is a modification of the Audion detector, which Dr. Lee de Forest, its inventor, calls the Oscillion. As applied to a low-powered transmitting instrument, this device consists of a tubular bulb containing a straight filament surrounded by a helical grid and cylindrical plate.

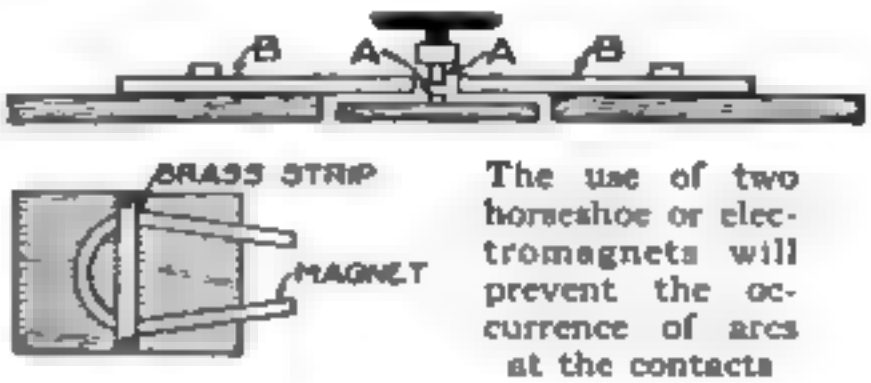


A modification of the audion detector used for wireless telephone transmission

The illustration shows a small panel Oscillion Telephone. The front dimensions are only about 8½ by 11 ins., yet the assembly includes the Oscillion bulb itself, a telephone transmitter, a potentio meter for adjusting the high potential applied to the plate circuit, a switch for starting and stopping the oscillations, a rheostat for the filament current, a switch (at the upper left-hand corner) controlling the radiated wavelength by cutting in more or less of the variable loading coil mounted back of the panel, and binding posts for connection with the antenna and ground.

Reducing Arcing at Key Contacts

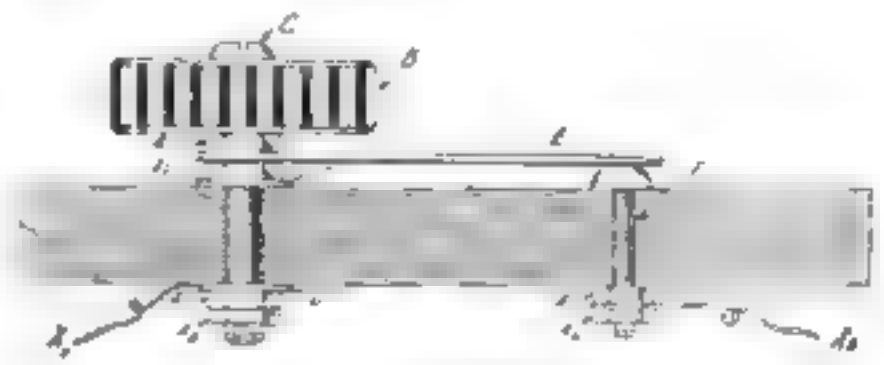
USING a sending key on the 110-volt circuit gave much trouble because of arcing at the contacts. This difficulty was remedied by placing two horseshoe magnets on opposite sides of the contacts. It was found that the magnets should be close to the contacts but should not touch them. The magnets were fastened on blocks of wood, with brass strips, as shown in the cut below. By their use, the arcing was decreased considerably. Stronger magnets or powerful electromagnets would be still better.—B. SCHUMM.



The use of two horseshoe or electromagnets will prevent the occurrence of arcs at the contacts

A Good Loose-Coupler Switch

THE diagram shows a loose-coupler switch which will positively stay tight. In the illustration, *A* 1 and *A* 6 are nuts of which *A* 1 may be used to elevate the knob. Note that *A* 4 holds *A* 3 in check. The nut *A* 5 may be omitted. The knob *B* is an ordinary wooden disk used in the game of checkers. The bolt *C* is of brass or nickel, and *D* 1 and *D* 2 are copper or brass washers. The washers are stationary but the nuts move with the knob. The strip of thin copper or brass *E* has its edges beveled at the contact buttons. The contact bolt is marked *F* and the contact wires *X* 1 and *X* 2. This arrangement is not only cheap but easily constructed. When the various parts of this switch are connected it will remain tight under all working conditions, necessitating no additional care.—F. C. HAMILTON.



A tight loose-coupler switch

A Quenched Gap with Metal Spacers

IN designing quenched spark-gaps a number of inventors have attempted to produce dischargers in which the spacing of plates, or length of gap, would not be determined by the pressure applied to the gaskets separating the elements of the gap. When thin pressboard or rubber composition gaskets are used under heavy pressure, the gaps sometimes become too short. This is especially likely to happen when the apparatus grows hot after long use. A method of construction patented by R. Pfund in late 1915, and shown in specification 1,161,520, from which Fig. 1 is reproduced, avoids some of these troubles by using metallic spacing-washers. The gap elements are made up, as shown in this drawing, from base plates 4 which have attached to them the raised sparking-surfaces 18. Insulating-rings 5 support metal rings 6, and, after the half unit consisting of 4, 18, 5 and 6 is assembled the active gap surface 18 is turned off so as to be exactly in the

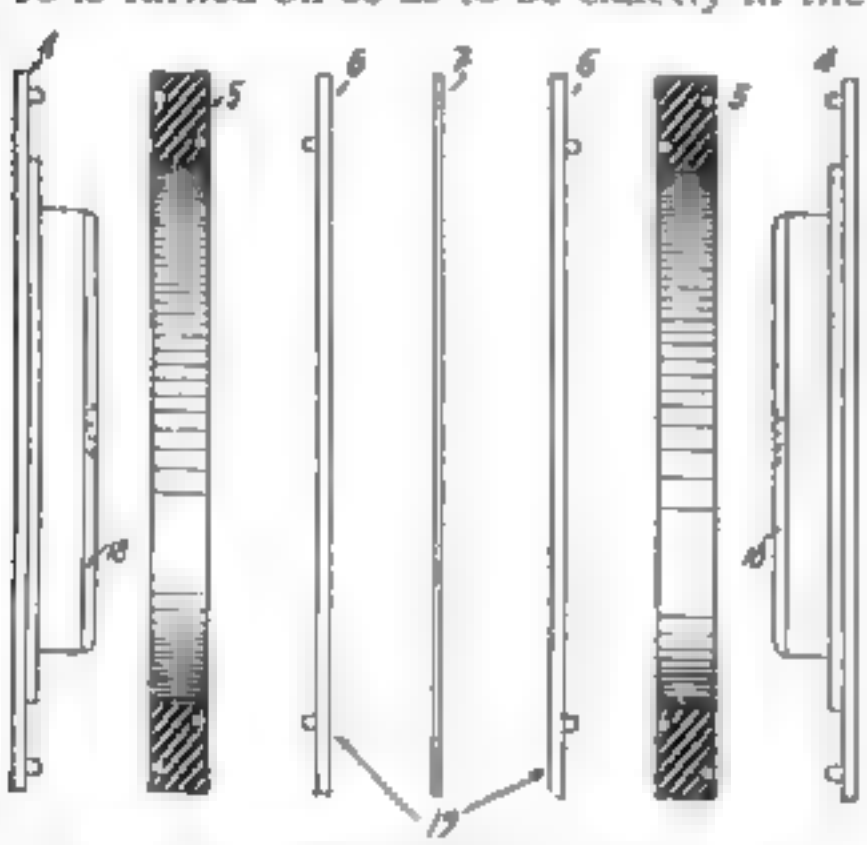


Fig. 1. Metallic spacing washers used in the new quenched spark gap

plane of the ring 6. Thus, when the metal spacing-washer 7 is inserted, the two sparking surfaces are held apart by it at exactly the right distance. Heat will not affect the washer 7 to any great degree, and its thickness can be made more nearly uniform than when thin insulating material is used. Of course, the true spacing will be held only so long as the insulating-rings 5 hold their shape; these, however, are far more rugged than the usual gaskets.

The complete assembly of the gap is shown in Fig. 2. Units built up as in Fig 1 are supported upon the two lower rods 10, and between them are inserted

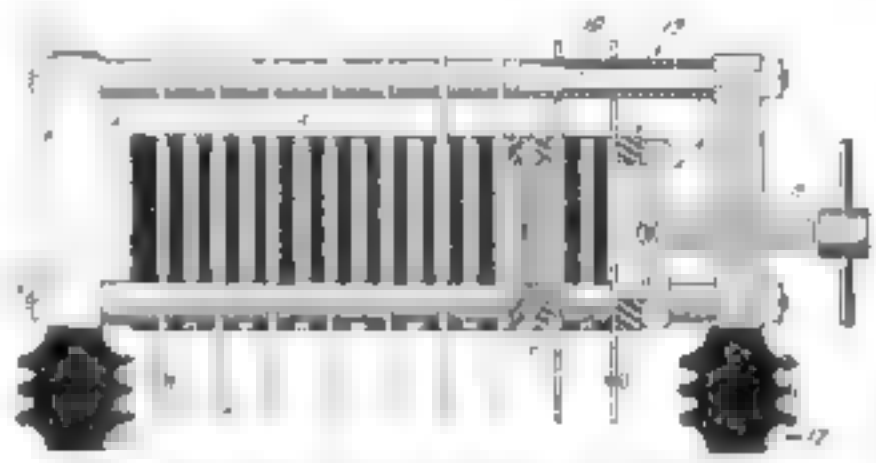
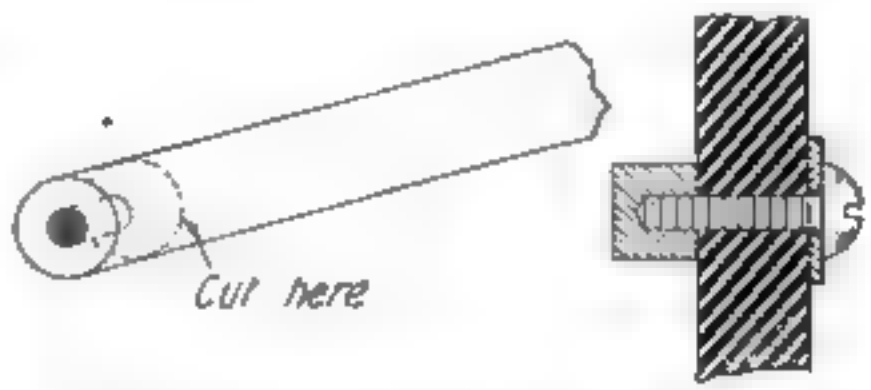


Fig. 2. The single units are built up in this form to complete the gap

larger cooling plates 8. The compression screw 16 serves to make the gaps practically air-tight, in the usual way. This construction makes demounting easy, since, immediately upon loosening 16, any of the elements may be removed for inspection or cleaning, without disturbing the cooling plates or the other gaps. If, when rubbing down the surfaces, the entire assembly 4, 18, 5 and 6 is slid over a flat polishing cloth, the active plane is maintained accurately in line with the surface of disk 6. The constant and accurate spacing maintains adjustments which give a clear spark tone.

Switch Points for Radio Instruments

VERY neat and serviceable switch points may be made of round brass rod of the diameter to suit one's requirements. All that need be done is to drill and tap the end of the rod and then cut off the length giving the desired height of switch points. A machine-screw is to be used for fastening it to the instrument panel. LOUIS LIND.



Make your switch points from pieces of brass rod by tapping the end and cutting it off at the proper length

What Radio Readers Want to Know

Receiving Condensers; Loading Coils; Transformers

E. C. M., Philadelphia, Pa., inquires:

Q. 1. Why are variable condensers of the rotary type used in preference to the sliding plate variable?

A. 1. Because they are usually better mechanically

Q. 2. Please give a formula for finding the capacity of a variable condenser and a condenser of fixed value.

A. 2. You are referred to any of the standard textbooks. It is not possible to compute this capacity with absolute accuracy, in most cases, and the best plan is to have your condenser measured and calibrated at a radio laboratory.

$$C = \frac{K}{900000}\left(\frac{u2}{4s}+\frac{u}{4\,\Pi}\right)\log\frac{16\,\Pi\,u\,(s+w)}{s2}\left(1+\frac{w}{s}\right)\log\frac{s+w}{w}$$

Where:

u = radius in centimeters
s = separation of plates in centimeters
w = thickness of plates in centimeters
K = dielectric constant of the separating medium
C = capacity in microfarads

For the capacity of a number of semicircular plates we calculate as above and then use the following equation:

$$C = \frac{y}{2}\,\frac{1}{}$$ x the capacity of two similar circular plates as above

Q. 3. What is meant by a loading inductance as used in wireless telegraphy?

A. 3. It is simply a coil of wire, usually made with a variable tap-off connection and used for increasing the time period of vibration of an oscillatory system. Connected in series with the antenna it has the effect of increasing the tuned wave length of that circuit. The loading inductance is usually mounted separately from the primary winding, and at a distance from its magnetic field. And additional coil of wire is sometimes connected in series with the secondary winding of a receiving tuner and it is then known as the "secondary loading coil."

Q. 4. How may the wave length of an aerial be obtained?

A. 4. By means of a wavemeter or roughly, by calculation from the dimensions of the aerial. A complicated formula for the latter method was given by Dr. L. Cohen in the "London Electrician" for February 1913, and another by Prof. Howe in the "Wireless World" December 1914 and January 1915. Simpler rules, though perhaps more approximate, were given in the article by John Vincent in the March issue of this magazine.

Q. 5. What is the wave length of a loose coupler 6 ins. in length with No. 28 wire on the primary and secondary. Which is preferable, No. 28 or No. 32 wire for the secondary?

A. 5. We cannot calculate the wave length of the tuner without more complete dimensions, and a description of the antenna used. For commercial apparatus No. 32 wire is preferred on the secondary.

Damping in Radio Circuits

H. L. G., Omaha, Neb., asks:

Q. 1. In regard to article on "Damping in Radio Circuits" by John Vincent in your May 1916 issue, I would like to ask whether the effect would be the same when using a heavier bob or weight to increase the period, instead of lengthening the rod or string.

A. 1. It appears that there exists some confusion as to the effect of changing the weight of the pendulum bob. In the ordinary simple pendulum only two things affect the time of swing, and these are the length of the string and the "acceleration of gravity" at the place the pendulum is set up. This latter item is constant for any one place on the earth's surface, and therefore the only way to change the time-period of a simple pendulum is to change the length of its string or rod—unless it is moved to a different locality, which has a different "acceleration of gravity." Adding to or substracting to the amount of material in the pendulum bob does not change the time of swing, so long as most of the mass is concentrated near the lower end of the system. Your correspondent can prove this very easily, to his own satisfaction, by timing a pendulum consisting of a bucket swung from the ceiling by light, strong cord. The time for a complete period will remain the same when the bucket is filled with water as when it is empty

If a spring pendulum is used instead of the simple gravitational pendulum consisting of a weight and cord swinging from side to side, the size of the weight will influence the period of vibration. When a weight is hung on a spiral or helical spring, and allowed to vibrate up and down, the vibration will be quicker the lighter the weight and the stiffer the spring.

It will appear from the above that the simple

pendulum can be adjusted to swing with a definite period of one second, or of two seconds, by changing the length of the string or rod, and in that way only.

Copper-Plating Leyden Jars

D. A. S., Midland Beach, Staten Island, N. Y., writes:

Q. 1. Can you inform me how I may prepare glass in order that the surface may be copper-plated? How can I prevent blistering? I hear much these days of the copper-plated Leyden jar.

A. 1. The process is rather expensive. One manufacturer coats the bare glass with a cold silver solution such as is applied to the rear of mirrors. The jar is then placed in a furnace and heated near to the melting point whereupon the silver is thoroughly burned into the glass. The jar is then allowed to cool slowly and afterward placed in an ordinary electroplating vat and given a heavy coating of copper.

Another manufacturer applies a cold silver solution to the inside of the glass and a coating of graphite held in place by shellac to the outside of the glass. The jar is placed in the electroplating bath without burning.

Dimensions for Transmitting Transformer

A. W., Fayette, Ala., writes:

Q. 1. Please give me the dimensions of the primary and secondary windings for an oscillation transformer for use with a 1 K.W. transmitting set. Please state the diameter of both windings.

A. 1. It is assumed that you desire an oscillation transformer of the pancake type, and if so, it should have the following dimensions: The primary winding has eight turns of flat copper ribbon placed on an insulating support edgewise, the copper being about ½ in. in width by 1/16 in. in thickness. The outside diameter of the winding is 10 ins. and the inside diameter about 4¾ ins.; the turns are therefore placed about ¼ in. apart. The secondary winding of the oscillation transformer may consist of about 18 turns of the same size ribbon, also spaced ¼ in. apart. The outside diameter of this winding is 14 ins. and the inside diameter about 4½ ins.

Q. 2. Should the ribbon be wound in the same direction in both windings?

A. 2. It makes no difference which way they are wound

Q. 3. In the construction of a condenser for a 1 K.W. transformer, should the tinfoil be placed on both sides of the glass plates and the plates then stacked together so that the tinfoil of one plate touches the tinfoil of the other, and should the copper ribbon for making contact with the tinfoil be brought out between the plates, and should the odd number of plates be connected to the right condenser terminal and the even numbers to the left, or vice versa? Would it be satisfactory to place the tinfoil on a glass plate, then lay on top of it another glass plate, followed by a second sheet of tinfoil, and so on throughout the series until complete?

A. 3. It is preferable to coat both sides with tinfoil and the best method is to place the foil on the glass plates with a good grade of fish glue, after which the plate is shellacked to prevent the foil from blistering. Alternate plates are connected to one terminal, and the intervening plates to the inside terminal The surfaces of the sheets of tinfoil from each plate should be pressed tight against the sheet next to it. The reason for this is that unless the tinfoil is firmly attached to the plates, a violent brush discharge takes place between the glass and the foil, causing blisters.

Q. 4. What should be the capacity in amperes for a transmitting key to break the primary circuit of a 1-K.W. 110-volt 60-cycle transformer?

A. 4. Owing to phase displacement in the primary circuits an ammeter will indicate from 14 to 16 amperes, but of course with no phase displacement the ammeter should read about 9⅓ amperes. The transmitting key should have a current-carrying capacity of 15 amperes.

Radio Frequency Changers

W. H. H., Cold Spring, N. J., asks:

Q. 1. Will you kindly give me a more complete description of the transformer which doubles the frequency of the current imposed on the primary winding, which you mention in the article entitled "Long Distance Wireless Telegraphy" in the August 1915 issue of this publication.

A. 1. It would be far too long an article to give in this column, but you will find one of the most complete short descriptions of radio frequency changers in print in the March 1915, Volume 3, No. 1 issue of the Proceedings of The Institute of Radio Engineers. This is a 35-page article and it covers not only static but dynamic, electrostatic as well as electromagnetic, frequency changers. It is fully illustrated and contains many graphs showing the relations of the several currents during the frequency changers. If you are at all interested in the subject, we most certainly recommend that you read this article. If you cannot obtain a copy of this publication from a library or member of the Institute you can purchase a copy for $1 direct from the Institute Secretary, 111 Broadway, New York.

Q. 2. To what degree is the core of the transformer saturated by the direct current?

A. 2. The core is saturated to the point known as the knee of the curve. It is the point where the saturation begins to increase very slowly with increase of magnetizing current.

For Practical Workers

An Opposed Cylinder Steam Engine

By Ray F. Kuns

THE steam-engine shown in the drawings is one requiring no machine work and is so designed that any ambitious amateur may feel certain of success if he is at all careful in his work.

The base should be worked out to the size shown in Plate 2. If no iron base is at hand the hardwood base shown may be covered with either tin or sheet-brass. If this is done the bottom should be covered as well as the top, and edges and all joints soldered to exclude moisture. If not covered the base should be painted or enameled to prevent it from warping when the steam and hot water strike it.

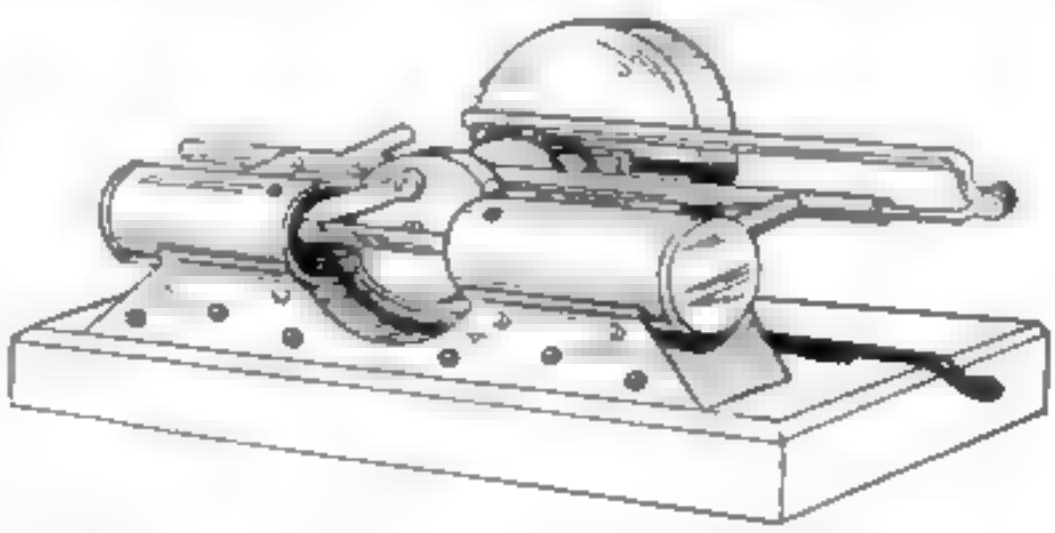


Plate 1. A steam engine having opposed cylinders, which can be constructed by an amateur

The cylinder support is shown as C S in Plate 2 and in detail in Plate 3. Work this up out of wood. Next cut out of brass or tin two strips as shown on Plate 3. These are fastened to the wood support with screws. To make a neat job the ends and top of the support may be covered with brass or tin and all joints soldered.

The cylinders are made from 16-gage seamless-drawn brass tubing. This is 1½ ins. outside diameter and should be entirely smooth and free from blisters on the inside. A piece 6 ins. long will make both cylinders and the eccentric ring, allowing for squaring and cutting. If no tubing is available an old bicycle-pump or automobile-tire pump will furnish the material. After one end of the tubing is squared up the length of the cylinder 2½ ins. is measured off on it and carefully marked, after which it is cut at that point with the hack-saw. The end is again squared up with the file and another cylinder marked and cut off, after which the two uneven ends of the cylinders are filed true and smooth.

Two cylinder heads are required, one for each cylinder. These are shown at *CH* in Plate 2. Use 18-gage brass or heavy sheet-tin, cut 1½ ins. in diameter and carefully solder in place.

The steam-chest, *SC* in Plate 2, is a piece of 18-gage seamless-drawn brass

tubing ½ in. outside diameter. This piece will be long enough to give the ports and intake as well as the steam-chest. Cut a piece 8 ins. long for the steam-chest. Square up both ends with a file and remove all burrs from the inside end with the point of a knife-blade. Next measure in from each end of the pipe ½ in. and drill a ¼-in. hole at each of these points for the ports. Be sure to drill the holes on the same side of the pipe.

The ports *P* shown in Plate 2 are made from the piece of tubing left from the steam-chest by cutting two pieces each ¾ in. long. File one end of each to fit the steam-chest tube and the other end to fit the cylinder tubing. Solder these pieces to the steam-chest over the holes drilled for the ports. A ¼-in. hole is next drilled ¼ in. from the cylinder heads in each of the cylinders, after which they are temporarily fastened in position on the cylinder support with these holes on top. Next solder the other end of the port pipes to the cylinders. Remove all burrs from the inside of the steam-chest and cylinders with file, emery-paper or knife-blade.

The slide valve-rod is made from a piece of ¼ in. brass rod 9 ins. long. It is first bent to the shape and flattened on the end as shown, SVR in Plate 2. Next file two notches around the rod. These are about ¼ in. wide and not quite 1/16 in. deep. The center of the first one is located 1¼ ins. from the center of the 3/16-in. hole, which is drilled in the flattened end for the bolt. The center of the other one is made exactly 7 ins. from the first one. Be careful to get these properly located as it is the most important part of the engine.

The slide valves are cast on the slide valve-rod just described. Use babbitt metal for this. A piece of the ½-in. tubing ⅜ in. long is first worked out and all burrs removed from the inside. A ½-in. hole is bored in a board ⅜ inch. deep. In the center of this hole the ¼-in. bit is placed and the hole bored on through the board. Now place the small piece of pipe in the ½-in. hole and slip the valve-rod into the ¼-in. hole, passing it down until the first notch is in the center of the pipe. The valve may be cast by running the pipe full of babbitt. Carefully remove from the mold and set it up for the other valve, using the same piece of pipe. When both valves are cast in place they are carefully fitted into position in the steam-chest. If they are found to fit too tight they may be scraped very lightly with a knife.

From the piece of 1½-in. pipe left from the cylinders make the eccentric ring. This is made just ½ in. wide. After it has been carefully worked into form and the edges rounded a trifle on the inside as well as out it must be used to cast the eccentric and piston-heads.

The small piece of pipe is then fitted and soldered to it, as shown in Plate 3.

The purpose of the eccentric is to throw the valves first to one side of the ports and then to the other. The eccentric mold shown in Plate 3 is used to produce the casting for the eccentric. In making the mold the expansive bit is used to bore a hole ½ in. deep in a block of wood. This hole should permit the eccentric ring to come into it evenly. After this hole has been smoothed the ⅜-in. hole mentioned above is bored as well as one on the other side of the center for pouring the metal.

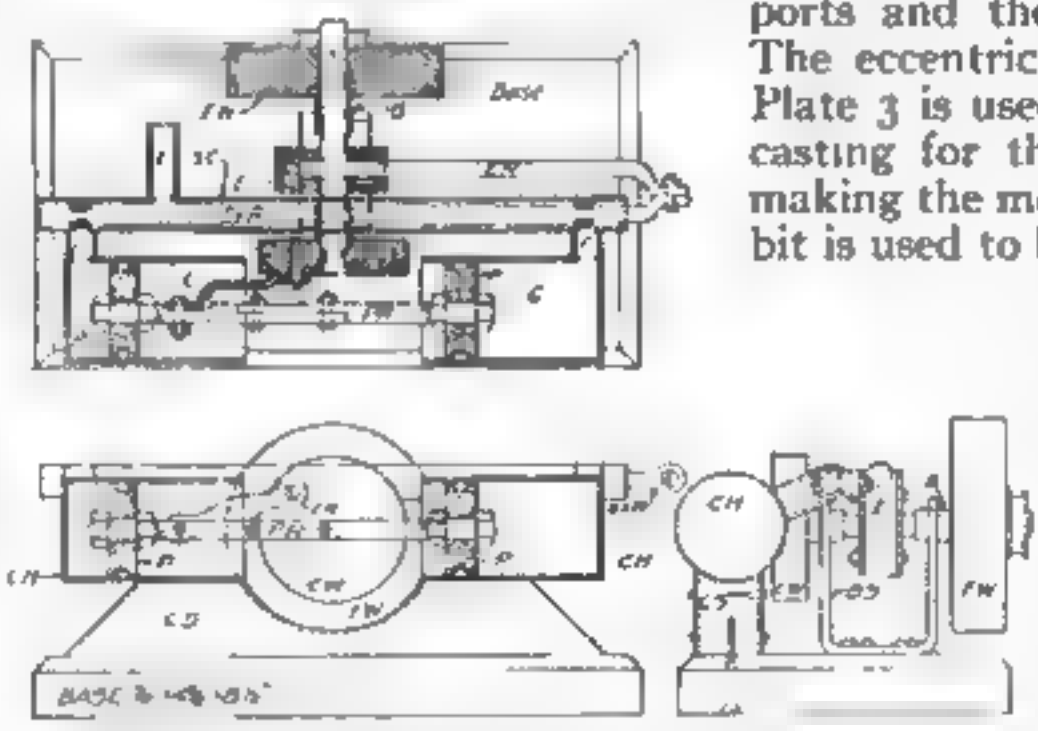


Plate 2. Construction details of the slide valves

Prepare the mold for pouring by installing the brass ring. After turning the open face of the mold down on a piece of paper laid on the bench and squaring up the piece of ⅜ in. steel, the mold may be poured.

The piston-heads may be cast in the eccentric ring. Simply lay the ring on a piece of paper on a flat surface and pour it full of babbitt. Two of these are required. After casting, the center is carefully located with a pair of dividers, after which a 5/16-in. hole is drilled through it. To cut the groove in the piston-heads the arrangement shown on this page is used. A block of wood has a 5/16-in. hole bored through it. A piece of 5/16 in. iron is threaded on one end and a piston held in place on it by means of locked nuts. The other end of the iron is run through the block and bent into the form of a crank. Drive a nail into the block for the ¼-in. chisel and the groove is cut by turning the piston and holding the chisel against it. The grooves are cut ¼ in. deep.

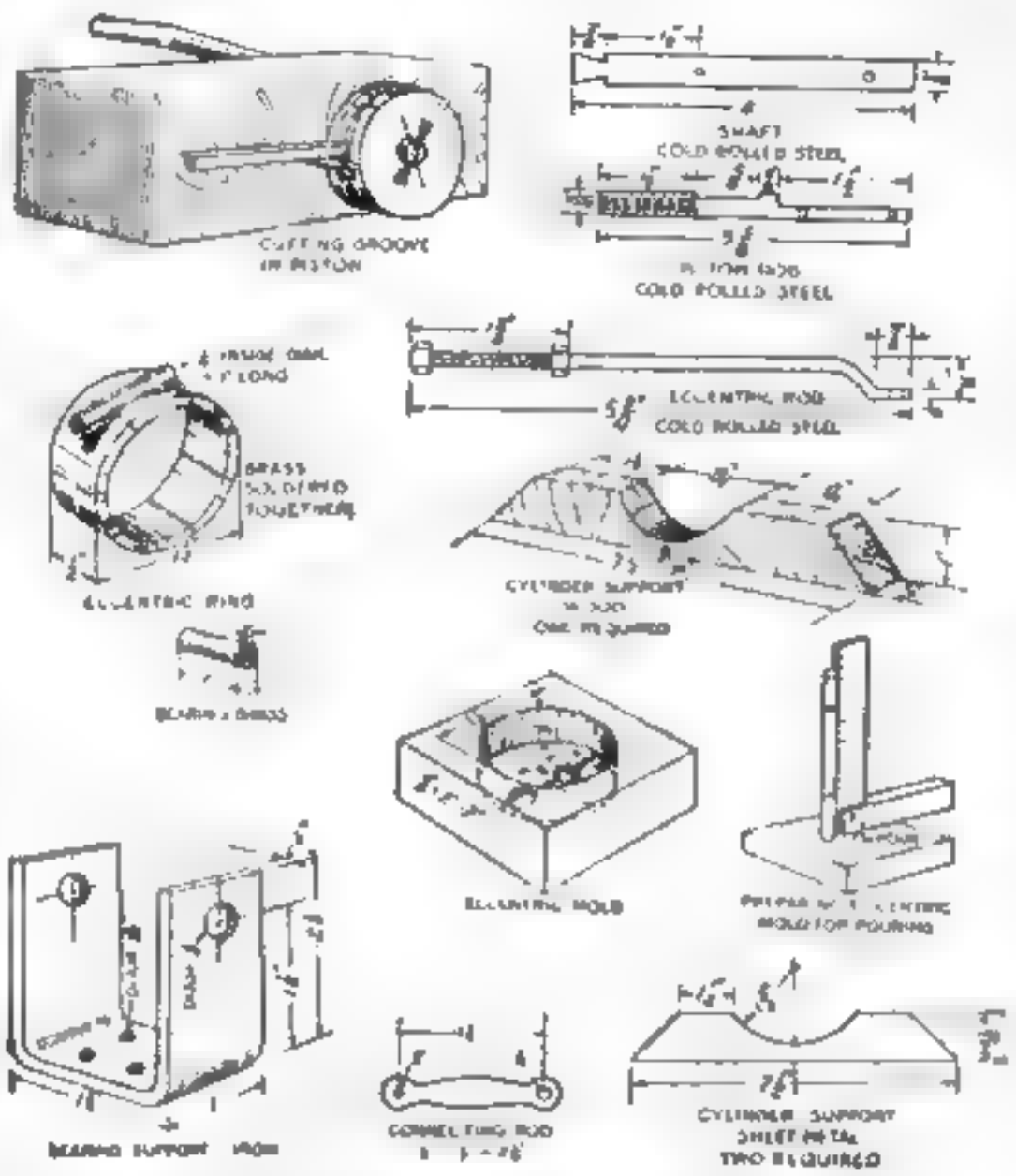


Plate 3. Diagrams showing dimensions of the various parts of the opposed cylinder steam engine

The piston-rods are worked out from cold rolled steel or brass. Only the one needs the ⅝-in. notch cut into it as that is for the connecting rod to fit into. The two inner ends of the piston-rods are lapped together and bolted with two ⅛ in. by ½ in. stove bolts. A ⅛-in. hole must also be drilled in the center of the space allowed for fastening the connecting rod. The pistons are held on the ends of the connecting rods by means of locked nuts. Note Plate 2.

The connecting rod is shown in Plates 2 and 3. Use ⅛ in. by ½ in. material, either brass or iron. The curves may be worked out with a file.

The crank wheel is ½ in. thick by 2 ins. in diameter. The mold is made as was the eccentric mold, except that no ring is used and the hole for the shaft is in the center. A hole must be provided for pouring. When pouring, be certain to have the shaft set square with the mold. Square up by the method suggested in the drawing.

The fly-wheel is made of lead or babbitt. In this case the mold is about ¾ in. deep and 3 ins. in diameter. The shaft should be in the mold when the casting is made.

The bearing support is easily made of either iron or brass. Bend to shape first and then lay off and drill the holes for the bearings. These are short pieces of pipe used for the steam-chest, ports, etc. Place the shaft through the bearings, and place the bearings in place in the support, when they may be soldered in position.

The shaft is shown in Plate 3. It is best made from cold rolled steel although brass will do.

Having brought all of the details to this point the most interesting part is now to be done.

In assembling, fasten the connecting rod in position on the piston-rod. Use a ⅛-in. rivet for this, but do not make it too tight. Pack the pistons with cotton waste, asbestos packing or soft yarn Assemble them in position in the cylinders, bolt them together and see that they work smoothly. Next place the shaft in position in the bearings with the eccentric and eccentric ring in place. Fasten the eccentric to the shaft by drilling a small hole down through both

of them and inserting a wire pin. The eccentric is placed midway between the bearings. The ring is slipped on the eccentric and the guide plates bolted fast. The fly-wheel is assembled on the outside of the bearing and pinned on the same way.

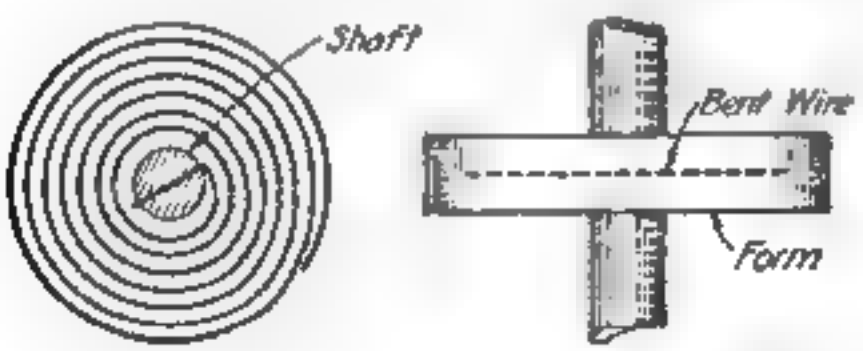
Place the bearing support with its assembled parts in position on the base. Try the connecting rod to be certain it will connect properly, and mark the points for drilling holes in the base. These want to go all the way through. Battery or stove bolts are inserted from the bottom and the support is bolted down.

Since the connecting rod will have to lead the eccentric by a quarter turn the heavy side of the eccentric will need to be turned until it is on the back of the engine, or on the side with the inlet, when the position of the connecting rod end may be marked on the fly-wheel. This will be ¾ in. directly above the center of the shaft. A ⅜-in. hole is drilled at that point and a head screw 1¼ in. fastens the connecting rod in position.

Next assemble the slide valve in position as well as the eccentric rod. These are bolted together on the outer end. Adjust the eccentric rod until the valves just cover the ports. When this is done lock it in place by means of the adjusting nuts. When all parts appear in their proper positions the cylinder may be permanently fastened in position by soldering them to the sheet-metal supports. Power for the engine may be secured from a boiler or radiator.

A Pully Made from Wax and Wire

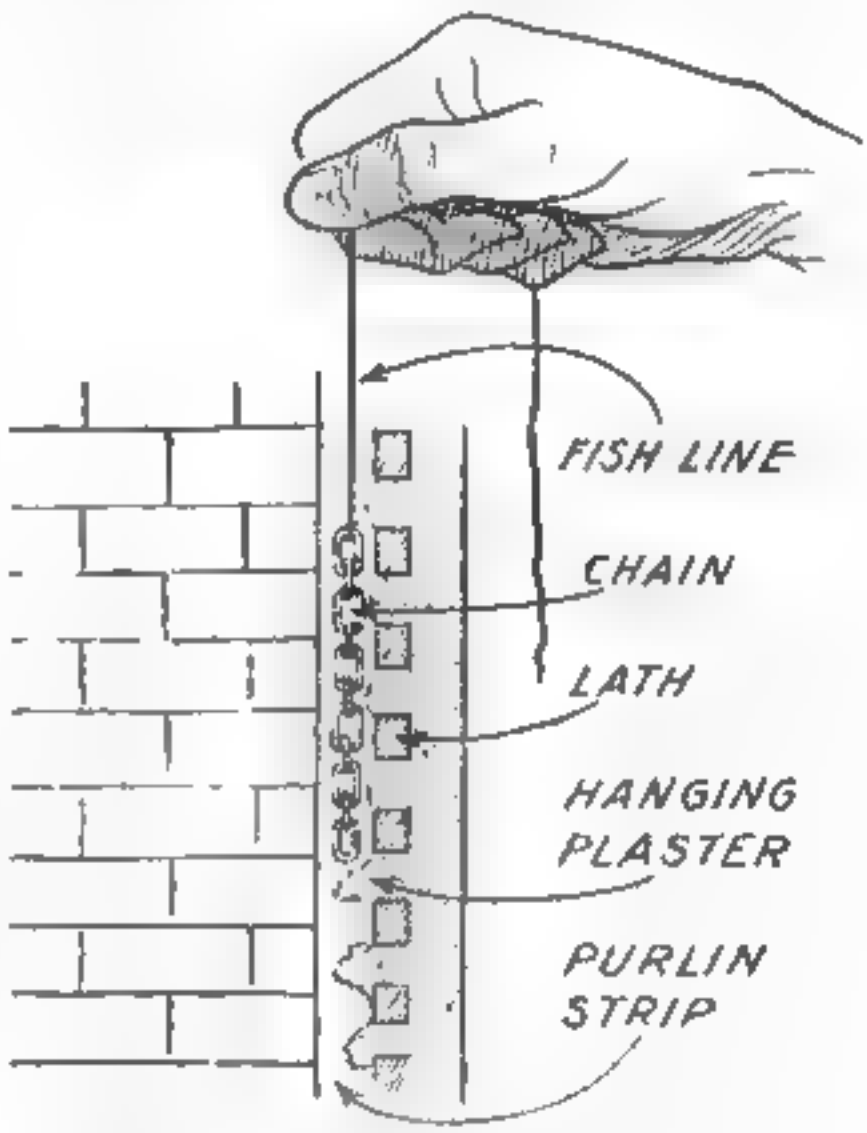
A PULLEY for a small motor or other piece of apparatus can be very easily made by drilling a small hole through the shaft where the pulley is to be located. A wire is put through the hole, held tightly, and bent as shown in the cut, making the outer curve a little less than the diameter the finished pulley is to have. The shaft that is to take the pulley is then held vertically, and a form the size of the pulley desired is placed around the coiled wire.



Sealing wax and wire can be made into a light pulley for a small motor

Sealing wax is then poured in and allowed to harden for an hour or two. The coiled wire will hold the sealing wax together, and will be found to be strong enough for light work.

Making a Space with a Chain Line



Making an opening for electrical wiring

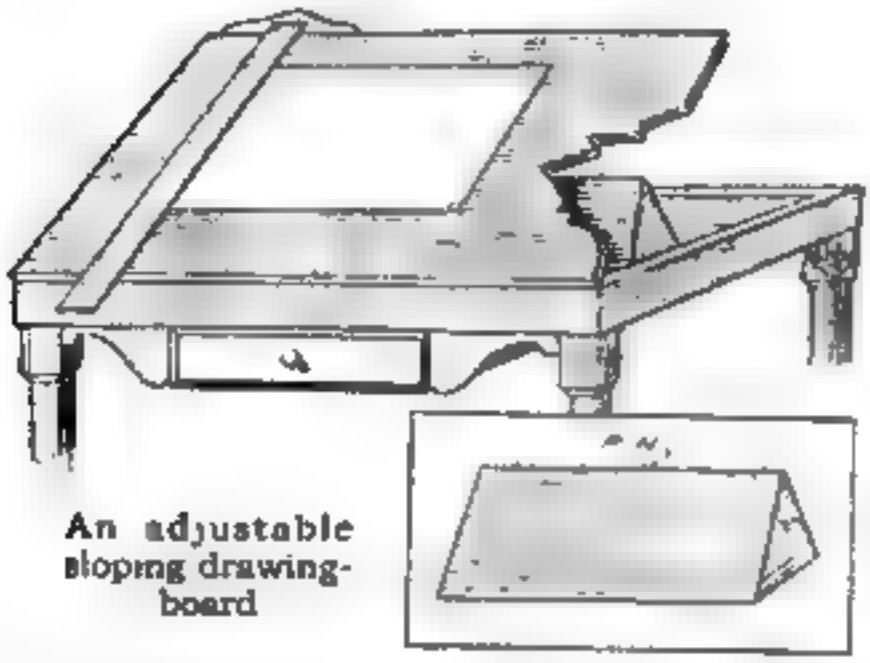
AN electrician was called to do some wiring in a brick house where the plaster was put on lath nailed to a vertical strip fastened to the bricks. In applying the plaster numerous hangers or hooks back of the lath were in the way of the conduit. It was an easy matter to insert the fish wire but how to make a sufficient opening for the conduit puzzled the electrician until a chain was seen in the tool-box.

This was tied to the end of the fish line and worked back and forth by jogging it up and down against the plaster until a large enough opening was produced to let in the conduit without any obstruction.—CHARLES F. SMISOR.

Straightening Warped Boards

WARPED boards may be straightened by the following method and they will stay straight. Resaw the board into strips, about 3 ins. wide. Joint all edges and glue the pieces together, being careful to reverse every other piece sidewise. Then plane the surface carefully and the board will not warp again.—L. G. ABELE.

Sloping a Drawing-Board



An adjustable sloping drawing-board

THERE is many a mechanic who finds that if his drawing-board were only sloped he could work much better.

The accompanying drawing will explain itself. A block of wood having three or four headless pins driven in the edge will hold the drawing board, the slope being regulated by the position of the block.—ALFRED R. WAGSTAFF.

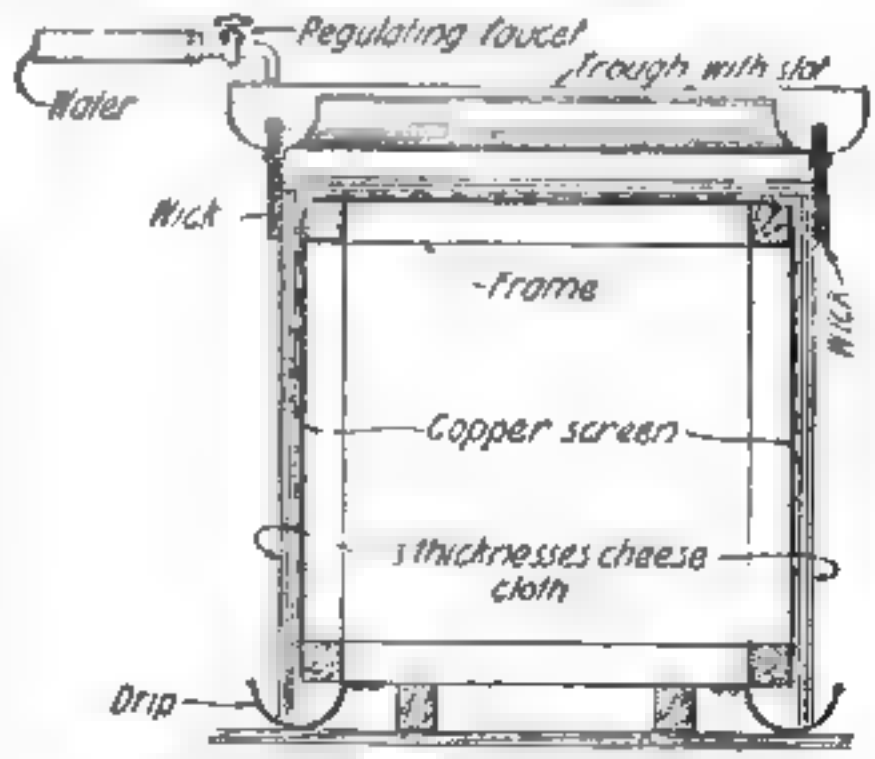
Keeping Food Without Ice

FOR the temporary preservation of such food products as rapidly spoil by heat, a modification of the Mexican "Olla" is used with success. The "Olla" is a water jar of porous, unglazed native biscuit work, which has the property of keeping the contained water cool, even in the severe temperatures of the southwestern deserts, when filled and hung in a current of air. Hanging in the sun keeps it cooler. The principle involved is the reduction of temperature due to rapid evaporation, the water which penetrates the clay being rapidly evaporated from the surface of the jar, lowering the temperature of its contents.

This principle is applied by dwellers far from an ice supply, as follows:

A frame of required size is made from a wood with no decided taste or odor The "cucumber" wood, from which the old-fashioned pump-logs were fashioned, is probably the best. Bass or linden is also used. This frame is covered with copper wire screen cloth, using turned copper tacks for fastenings. This again is covered with two or three thicknesses of cheese-cloth, stretched and tacked A tin gutter is so made that a properly designed slot in the bottom may be filled with cotton lamp-wicking, which projects in such manner as to touch the cheese-cloth enclosure, to which it is stitched at intervals to insure positive contact. The floor of this arrangement is elevated in such a way as to permit any excess of moisture reaching the cheese-cloth to drip off and run away to waste. By means of a regulating valve the water supply admitted to the upper gutter is just sufficient to keep the cheese-cloth constantly damp. The entire apparatus should be located in a cool passage or a shady porch. In either case a free circulation of air is essential. The evaporation reduces the temperature inside the device to a noticeable degree.

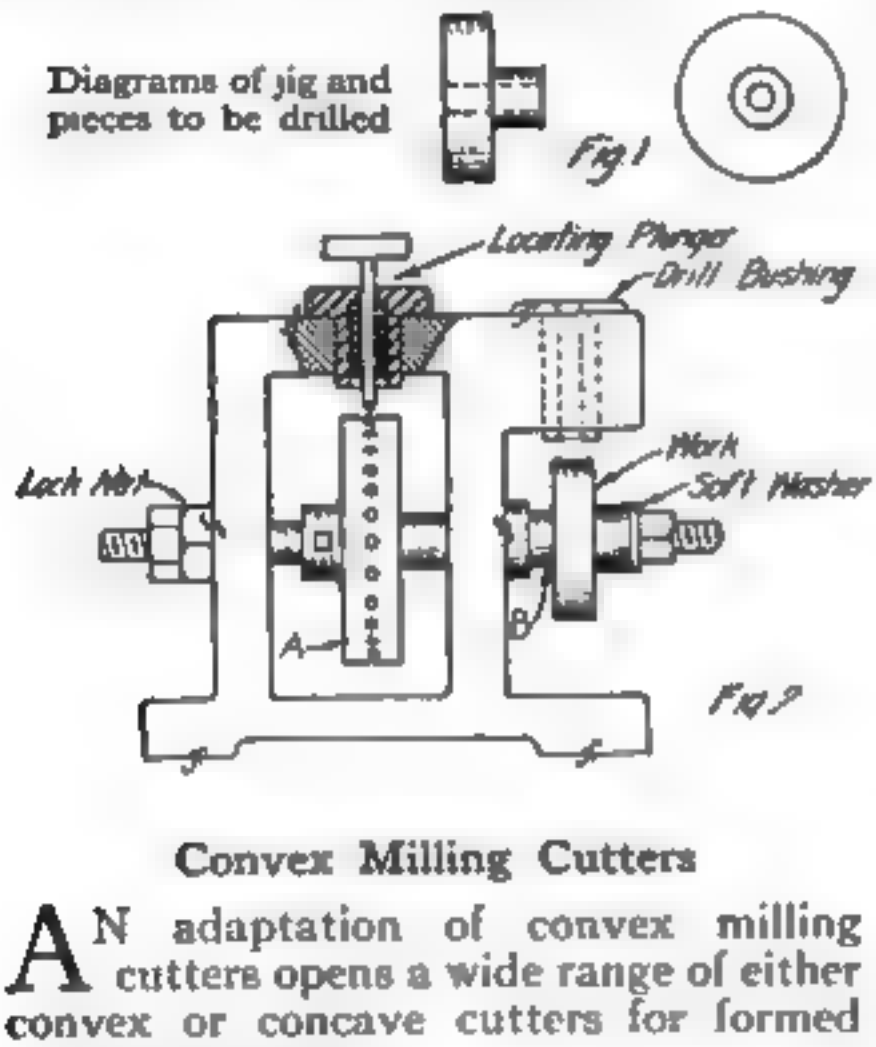
If a pressure source of water supply is available, it may be used. If not, a bucket can be provided with a proper faucet, and furnish the water supply. A collapsible modification of the "Olla" carried by a picnic party will replace the thermos bottle as a means of keeping the liquid refreshments cool.



Constant evaporation of water from a strip of cheese-cloth keeps the interior of the box cool in the hottest weather

Jig for Drilling Holes in Peripheries

THE jig shown in the drawing was designed for drilling holes in the periphery of the blanks shown in Fig. I. The piece *A* is made in the milling machine, the divisions being obtained by means of the dividing head. The blanks are held on the spindle *B* by means of the nut. The plunger holds it in position while the hole is being drilled. The spring prevents vibration from loosening the plunger. The piece *A* can be made with the holes spaced equally or not.—C. ANDERSON.



Diagrams of jig and pieces to be drilled

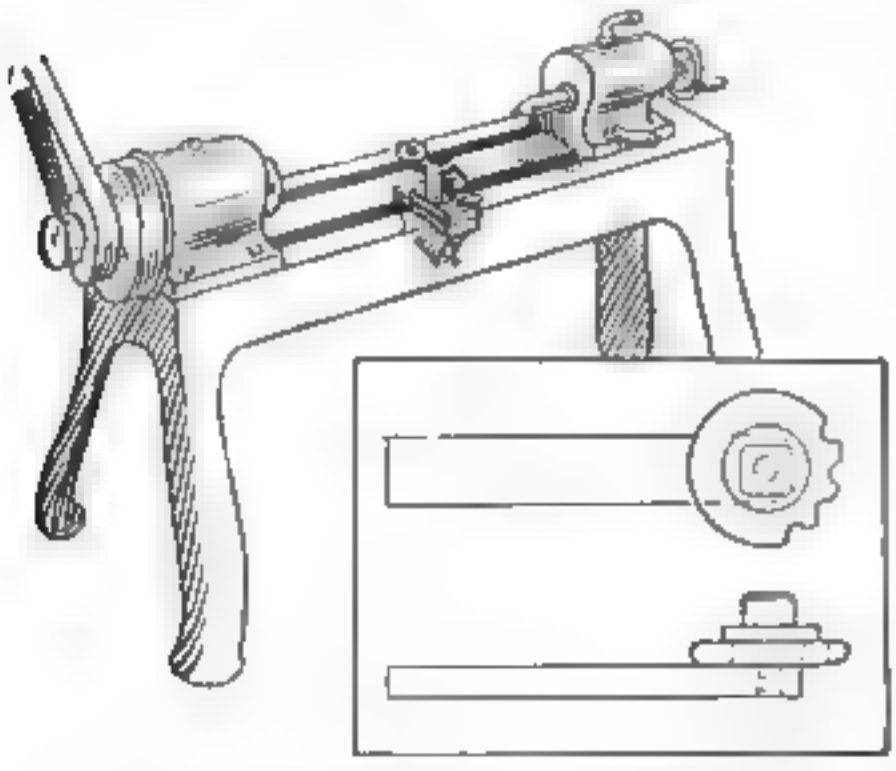
Fig 1

Convex Milling Cutters

AN adaptation of convex milling cutters opens a wide range of either convex or concave cutters for formed work in the lathe.

All that is necessary is a piece of mild steel milled so as to enter the tool-post, which is drilled and tapped on one end to receive the stud with the body turned to fit the hole in the cutters, and milled square or hexagonal on the head for the monkey-wrench.

This holder is cheap to construct and the saving in speed-formed lathe tools by this method amounts to many times its cost.—GEO. P. BREITSCHMID.



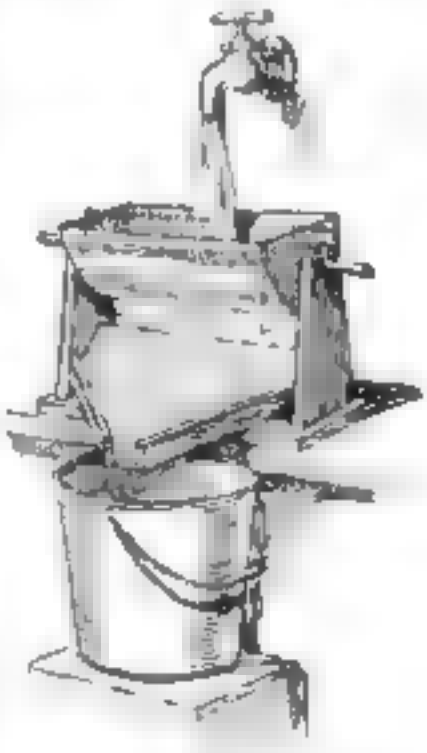
A holder of milled steel for the cutter is a saving in convex milling

A Painless Way of Killing Chickens

CHICKENS may be killed quickly and painlessly in the following manner. Procure a piece of stout cord or rope about five feet long and make a slip noose at one end. Fasten the other end on a pole or the side of a wall so that the noose hangs about three feet from the ground. Put the chicken's legs in the noose and draw it tight. Grasp the chicken's head near the mouth with the left hand (the chicken will open its mouth voluntarily) and with a small sharp-pointed knife, reach into the chicken's mouth over the tongue, to where the head joins on to the neck. By giving a quick jerk with the knife, the jugular vein will be severed. This is a quick and painless way of killing chickens.—JOHN D. MACKNIGHT.

Measuring Bucket for Flowing Water

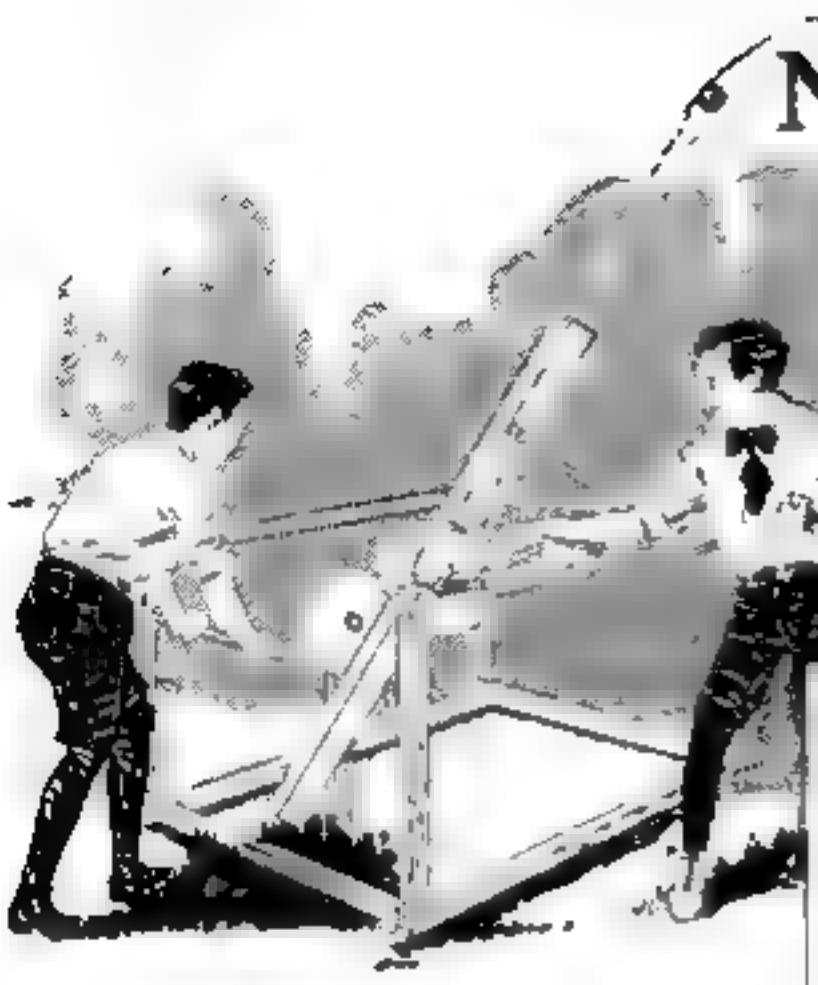
A BUCKET which measures exact quantities of water from a flowing stream is shown in the illustration. The amount measured depends on the size and location of the shaft. A counter is attached to the shaft to register the amount of discharge from the bucket as it tips to turn out the water. The overflow occurs when the water reaches a level that throws the weight off balance so far that it turns the bucket on its bearings and spills the contents, after which it rights itself for another charge.

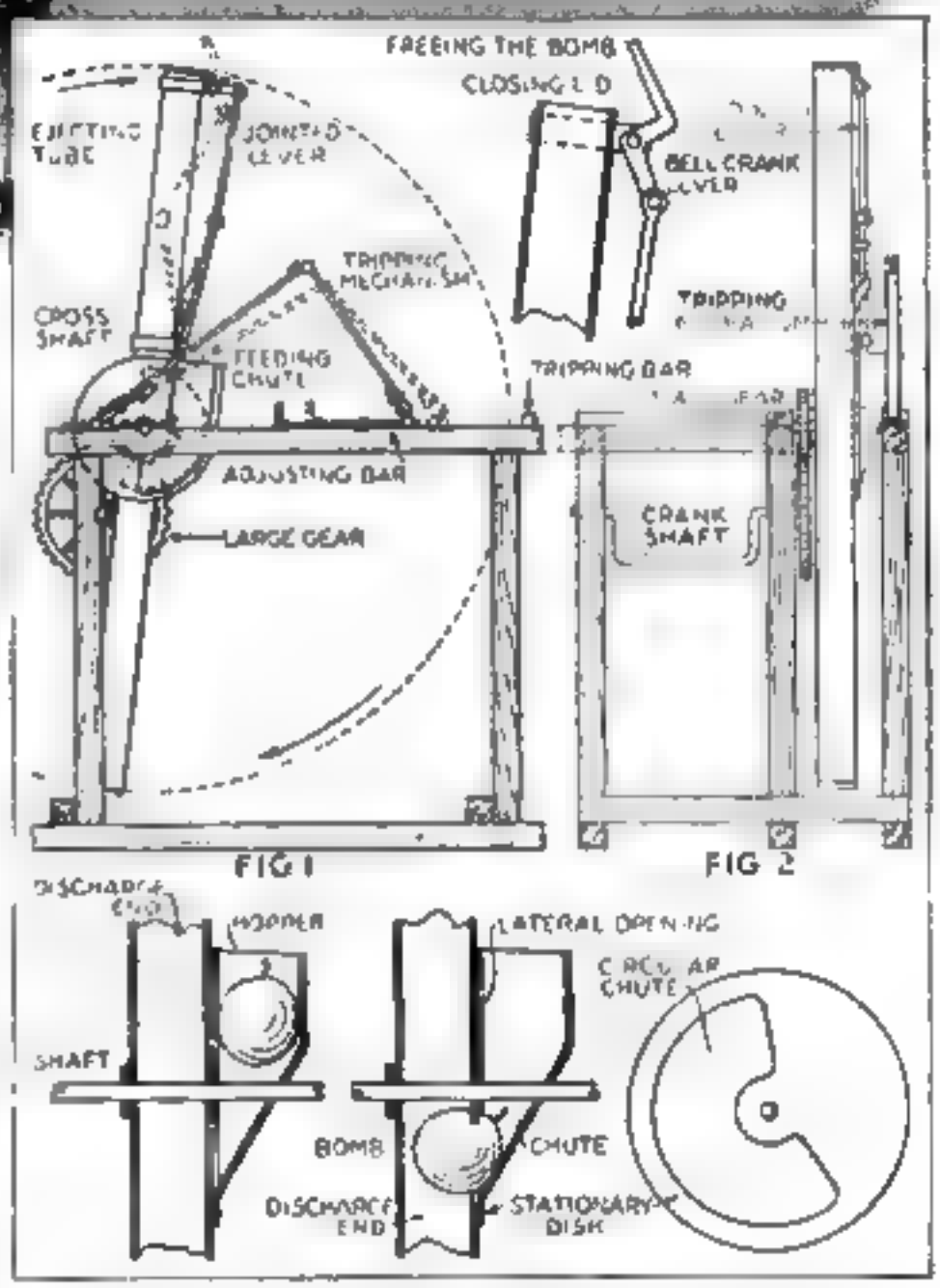


Ingenious device fo measuring flowing water

Making a Bomb Thrower for Sham Battles.

By J. S. Zerbe





By means of centrifugal force the apparatus shown above throws bombs a surprisingly long distance. With two such machines, boys can wage battle as long as their ammunition holds out

MODERN methods of warfare have developed, among other things, the throwing of hand grenades, or bombs,—projectiles which are used at close quarters against an enemy's trench and also for the purpose of resisting a rush. The use of this weapon does not depend so much on the amount of actual damage which it accomplishes as it does upon the disorganizing results in the ranks of the enemy following the explosion. Many grenades are now provided with chemicals which produce irritating or stupefying gases designed to halt a charge or to silence the activity of a trench about to be stormed.

The disadvantages are the inability of the throwers to propel bombs a sufficient distance to do the most effective work and the inaccuracy of delivering the shots. In action during battle it is difficult to follow up a correctly-put shot with another which will be sure to reach the same spot.

The grenade is a device which can be made for throwing small projectiles, and in such cases the gear-wheel described need not be used, since speed is not so essential. Its use, moreover, will teach important lessons in the trajectory of projectiles.

The device utilizes centrifugal motion and in this respect resembles the action of the arm in throwing an object. Its use in warfare will effect a wonderful change in the handling of this class of projectiles. The drawings above show a side view, Fig. 1, and a front view, Fig. 2.

A wooden or metallic frame is provided which comprises six posts, a base upon which they are mounted, and three top stringers. Two of these stringers are

mounted close together to receive a cross-shaft which carries a tubular body four inches or more in diameter. This tube is preferably square in cross-section, and the shaft passes through it midway between its ends.

At one side of the tube is a small gear-wheel which meshes with a gear twice the diameter. The latter gear is mounted on the end of a shaft thirty inches long, which has a journal-bearing near the large gear; its other end is journaled to the side of a post. Between the two bearings the shaft is bent to provide a crank so that two men can operate it.

The important features are to load the thrower and release the missiles, both of which functions are provided for by simple mechanical expedients. The loader comprises a lateral opening in the side of the tube, and covering this opening is a stationary disk which has a concentric opening therein which extends half way round. A chute covers this opening, the lower end of the chute being gradually drawn in to the tube, so that when a hand grenade is dropped into the mouth of the chute and the opening reaches the upper end of the concentric opening, the inclined side of the chute will cause the grenade to move toward the throat of the tube and finally drop to the discharge end.

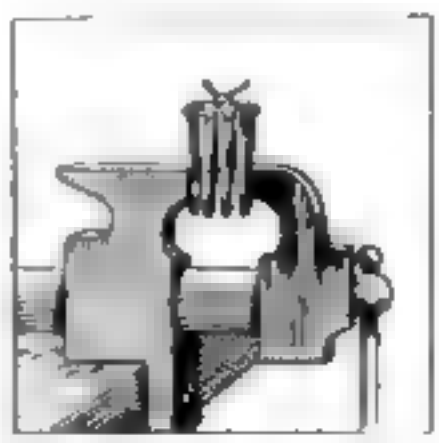
This motion of the grenade takes place while the discharge end of the tube is moving downwardly, and as the tube is in constant motion on its axis the missile swings around one-half of the ark formed by the end of the tube, a distance of nine feet before it reaches the ejecting point.

The ejecting end of the tube has a lid hinged at its side, and a bell-crank lever arm projects out at one side. This arm is connected by means of toggle-jointed levers, one of these being hinged to the tube near its axis. The two levers are connected together by means of a rule-joint hinge, and are of such length that when the lid is closed they are out of line with each other, and thus automatically prevent the lid from opening and discharging the missile in the tube. When the tube reaches a predetermined point the toggle-jointed levers strike a spring finger which causes them to swing back and instantly open the lid, drawing down the bell-crank lever arm. The result is that the grenade is free to shoot out.

Immediately thereafter the projecting lid reaches a cross-bar on the frame, which swings it back to a closed position, ready for the next missile. To provide a means for regulating the point of discharge the frame is provided with a pair of bars hinged together so as to assume an A-shaped form, the lower end of one bar being hinged to the top stringer, while the lower end of the other bar is hinged to a horizontal arm which rests on the stringer. This bar is provided with a pin so that by moving it back and forth the upper jointed ends of the two bars, where the spring finger is located, will determine the tripping point for releasing the missile.

Two men can easily swing the tube at the rate of ninety revolutions a minute, and assuming that the bomb weighs eight pounds, the unit of force transferred to the grenade is 230, compared with 45, the maximum available when throwing by hand. The advantage of the device is the great accuracy with which the bomb can be thrown. When the speed of the swinging tube is the same the bombs will reach the same area unfailingly. From fifty to a hundred missiles can be thrown a minute.

To Compress a Coil-Spring



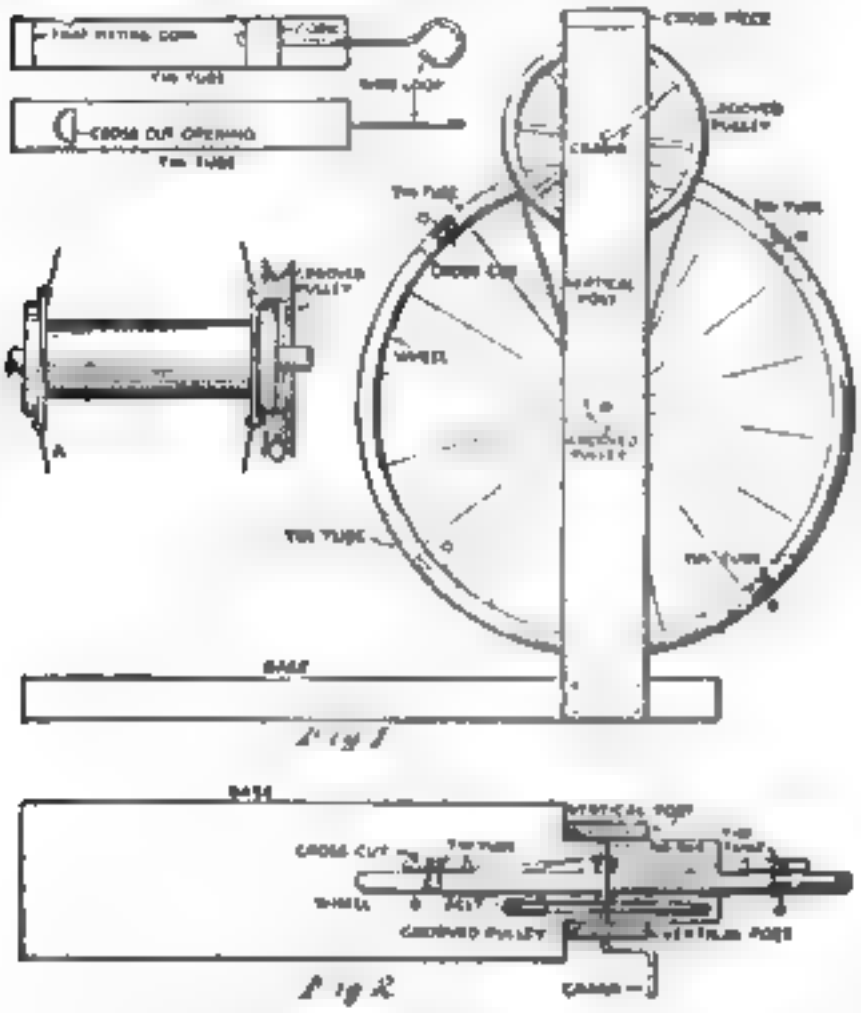
A good way to compress a recalcitrant coil-spring

SOMETIMES it is difficult to compress a coil-spring. The spring always seems to fly off at the wrong time. To eliminate this, place the spring in a vise and compress it as far as it will go. Then run a piece of strong twine through the inside and tie it. The spring is held in a clamp, or if not too strong is held in the fingers, and the part that was tied is placed in the vise and another piece of string tied through the coil. This gives two strong holdings and the spring is then slipped over the shaft.—NORMAN S. MCEWEN.

The Whistling Bicycle Wheel

A MOST interesting toy to teach young people the value of harmonic sounds is a device which any boy can make. Fig. 1 of the illustration shows a side view and Fig. 2 is a top or plan view.

Small rubber-tired wheels 10 ins.



The various parts employed in the construction of the musical wheel are here shown in side and plan views

or more in diameter are purchased at any supply house, and are mounted on ball-bearing spindles ready to be attached to a frame. In this description a wheel 12 ins. in diameter is used.

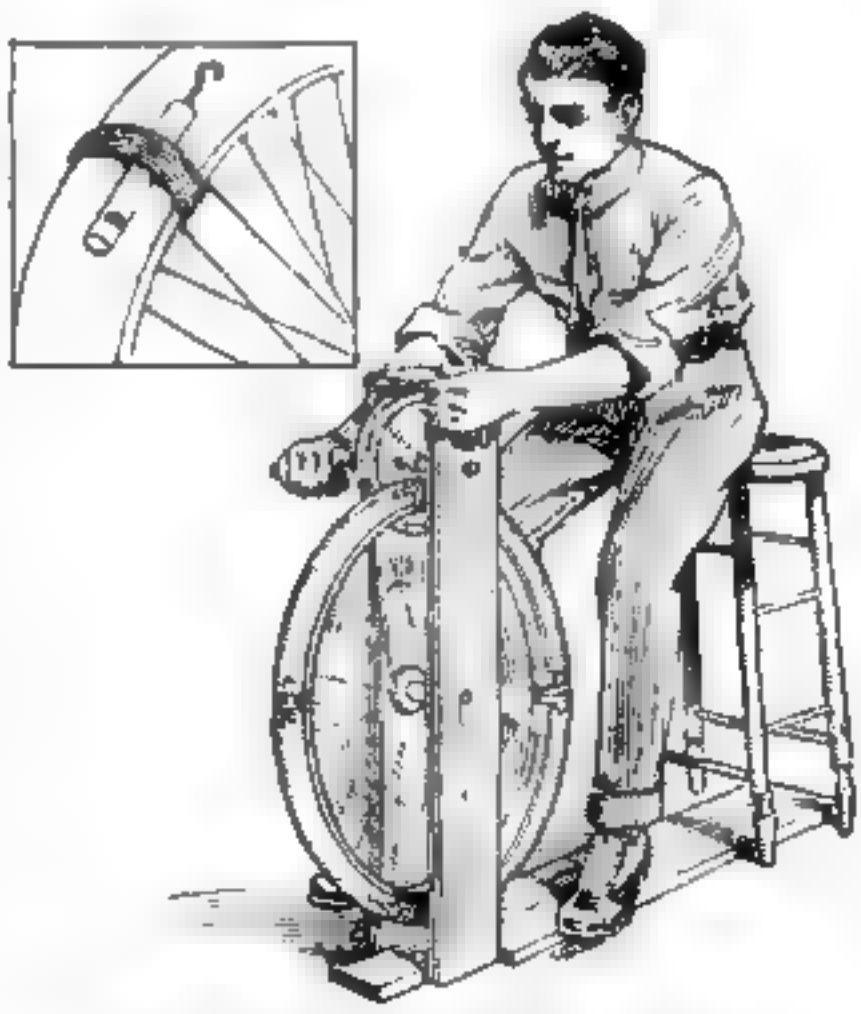
The frame comprises a base preferably 2 ins. thick, 5 ins. wide, and 33 ins. long. Near one end is a pair of vertical posts secured at their lower ends to this base, and they extend upwardly 33 ins., each being made of ¼ in. material. The upper ends are held in alinement by a cross-piece. A grooved pulley, about 2 ins. in diameter, is fastened to the hub of the wheel at one end, which can be done easily by a pair of bolts. The other grooved pulley, 8 or 10 ins. in diameter (such as is used on sewing-machines) is mounted directly above the small pulley on a round rod, one end of this rod being bent to form a crank. A common sewing-machine belt is placed on these two pulleys.

This arrangement enables the user to speed up the wheel so that it rotates rapidly. The harmonic devices are simply tin tubes, each ¾ of an in. in diameter, and 4 ins. long. By means of a file a cross-cut is made so that the opening is ½ in. across. This cut should be ¾ in. from the closed end.

A tightly-fitting cork ¼ in. long is placed in the end of the tube, and the other end of the tube is provided with a cork designed to move in and out, but tight enough to prevent leakage of air. To this cork a wire loop is attached so that the cork may be drawn out at will and adjusted at the proper place.

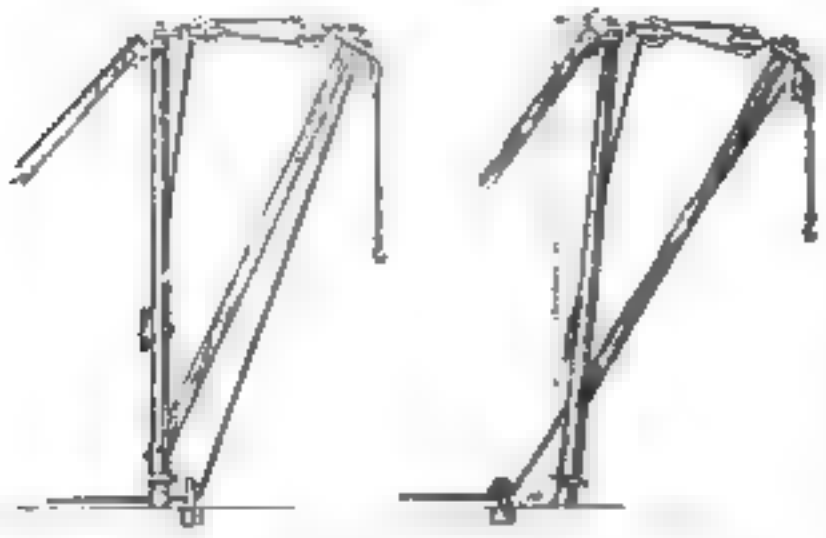
The pitch of each whistle thus made depends on the location of the cork within the tube; the nearer it is to the opening the higher will be the pitch. The smaller the tube the more piercing will be the note, so that any number of these whistles may be attached to the rim, some small and others large, thus giving shrill or somber sounds. Instead of tin, papier-maché, brass, or copper tubes may be used. The different materials give what is called the timber tone-color, or quality to the sounds.

These whistles may be tied to the rim of the wheel at various angles with reference to the rim. This will have the effect of imparting peculiar effects to the tones.—J. S. ZERBE.



A wide range of musical tones can be produced with this home-made outfit

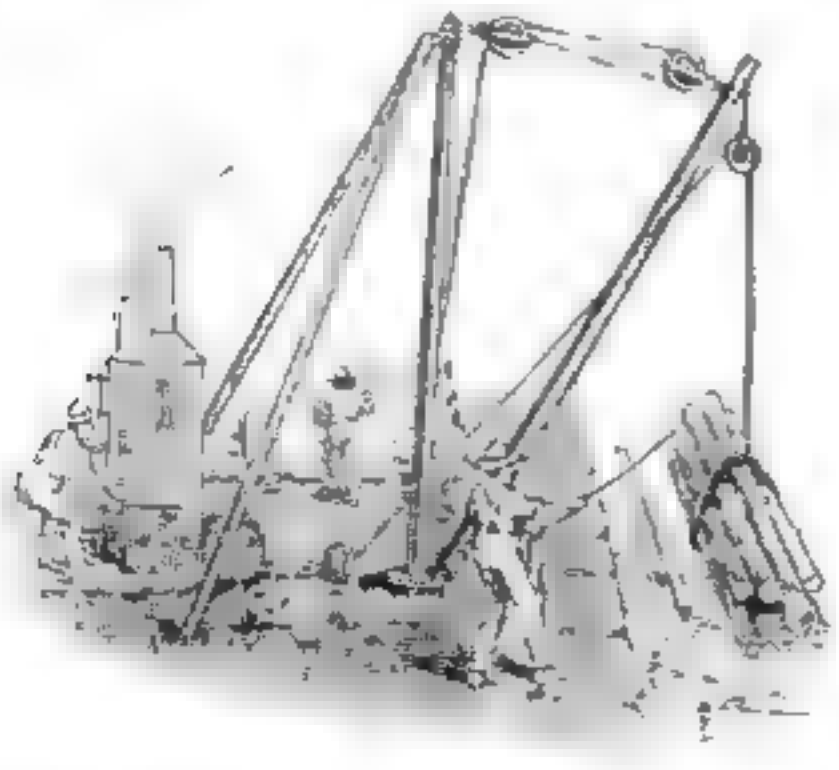
Hoisting Timbers Rapidly



At the left is shown the usual way of hoisting logs. At the right may be seen a new arrangement which saves power

SEVERAL thousand cedar poles can be removed from a river and deposited on flat cars alongside by means of an ordinary "stiff-leg" derrick with a hinged boom. Instead of setting the mast vertical, the top should be inclined about 18 ins. toward the river, its height being about 50 ft.

Instead of attaching the snatch-block for the hoisting cable to the foot of the mast, anchor it about 18 ins. from the foot of the mast, on the land side. In this way the boom is swung around by the cable when the load is lifted, and when the load is dropped the leaning mast causes the empty boom to return over the water, thus making it automatic each way through 180 degrees. By the observance of such a simple expedient as tilting the mast, a great deal of labor is saved.—J. L. BAYLEY.



With this newly arranged derrick large quantities of logs can be raised from a river and deposited on flat cars in a short time

An Adjustable Tap Wrench

A serviceable wrench

ONE of the best tap wrenches to be had can be made in a few minutes by anyone following these directions:

Cut a piece of ⅜-inch sq. tool steel to 10 ins. long, exactly in the middle, leaving two 5-inch pieces. Lay these pieces over each other a distance of 1½ ins.; clamp the lapped ends in a vise and ⅜ in. from each end of the lap, drill a No. 8 hole through the lap. In one piece tap the holes with a 14-24 tap, and redrill the holes in the other piece with a ¼-inch drill. Use two 14-24 cap screws 1 in. long, and file the threads off a distance of ⅜ in. from the head. Put your two pieces together and mark off the exact center of the lap, then file a V-shaped slot 3-32 in. deep in each piece, to hold the tap.

Round off the handles with a file and emery cloth and, if desired, the wrench may be hardened to a blue steel finish. This wrench will take anything up to a ½-inch tap. For a larger and stronger wrench, use heavier stock and longer handles.—L. E. FETTER.

Three Oil-Proof Lutes

ONE of the best known oil-proof lutes contains the following ingredients:

Good glue . . . . . 2 parts by weight
Glycerine . . . . . 1 part by weight
Water. . . . . 7 parts by weight

First soften the glue with the water; then melt and add the glycerine. This is a good lute for rendering corks vacuum-tight, and for stopping small leaks of almost anything except water and steam.

A lute suitable for use in laboratories and plants handling oil vapors is a putty made of molasses and flour.

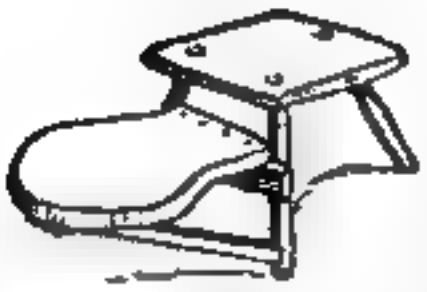
Another useful and very satisfactory oil-proof lute contains the following substances:

Glycerine . . . . . 90 parts by volume
Water. . . . . 10 parts by volume

These ingredients are to be made into a stiff putty with the following:

Litharge . . . . . 90 parts by weight
Red lead . . . . . 10 parts by weight

This mixture takes several hours to stiffen and about a day to set.



A stool with a board to hold the milk-pail

A Simple Home-Made Milking-Stool

THE illustration shows a very easily-made milking-stool, which requires merely a few boards and some sticks. The sticks are used for the legs. Half way from the seat of the stool to the floor, a board is nailed, running parallel to the floor. This supports the board which holds the milk-pail. The pail board is held in place by two braces on the bottom of the legs. A board is then needed under the legs for holding the bottom of the braces. This is a satisfactory and practical article for the farm boy to make.

Make Your Own Lazy-Betty

A LAZY-BETTY is a revolving affair placed in the center of the dining table to facilitate service when no maid is employed. The ones which are purchased are usually circular. Here is how one was made:

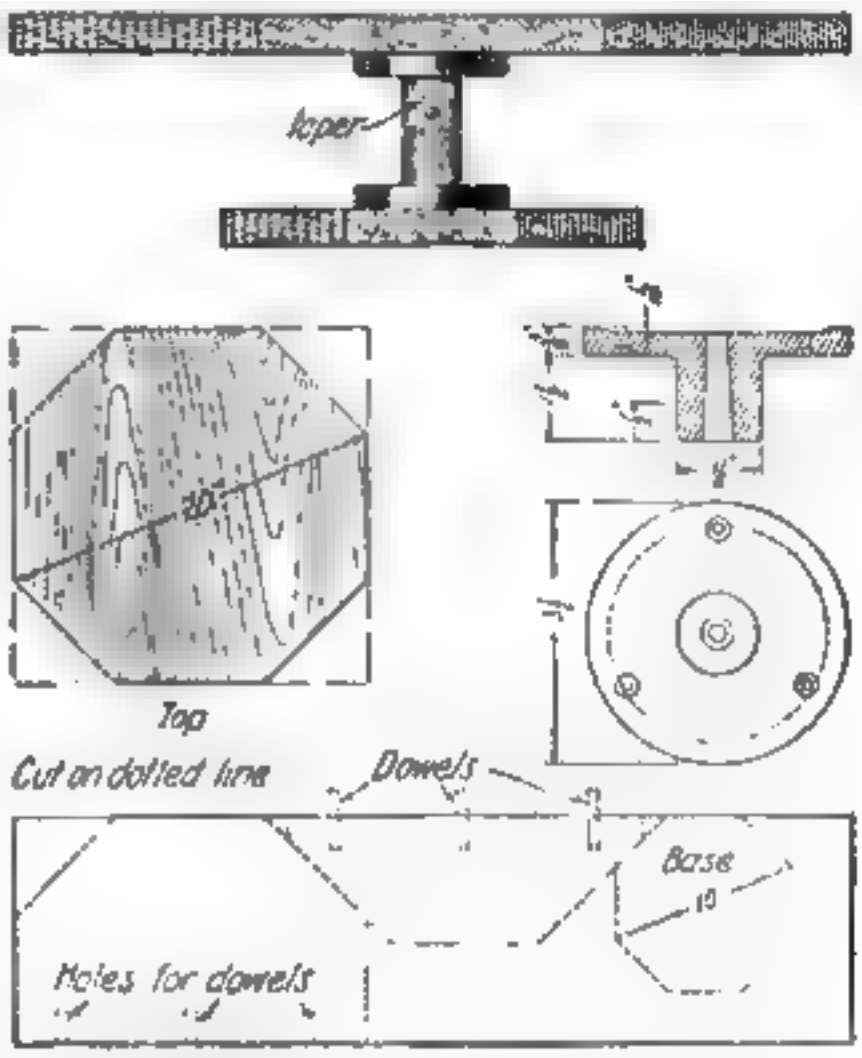
The top was an octagon 20 ins. across the diagonal. One of the unused extra leaves of the dining table furnished the material. The table was 54 ins. in diameter, and the extra leaf was thus 12 ins. wide by 54 ins. long, furnishing ample material. The base was a similar octagon, 10 ins. on the diagonal. A simple cast brass socket with steel stud furnished the connecting link.

The octagon is a figure of eight equal sides. By laying out a circle 20 ins. in diameter, drawing two diameters at right angles, and bisecting these angles again, the points are found. A similar procedure with a 10-in. circle lays out the base. The edges were carefully jointed with a fine-set plane. Then saw cuts were made as follows: 1-2-3-4-5, to produce the two pieces for the top. The cuts for the base are obvious. The top was fitted, and when contact was secured, it was glued and clamped.

Two stout cleats were nailed on an old table top about 24 ins. apart. Two sets of wedges were made, the matched joint was coated with glue, a piece of paper was laid on the table so the glue would not stick, and the top was wedged up, as shown. A heavy weight was placed on it to prevent buckling and the job was set aside for 48 hours.

In the meantime the base was cut out and furnished, a small hole, 1/16 in., drilled on its center, and the castings for the turntable were taken in hand

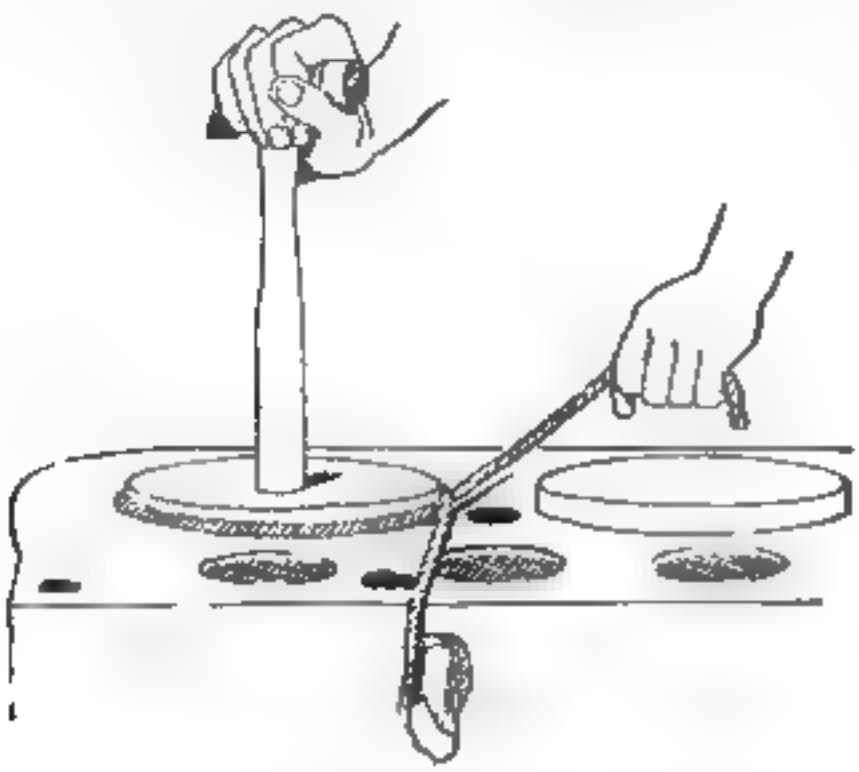
The steel pin fitting the tapers was turned true and fitted to the upper casting and pinned. The lower casting



Constructional details of the self-server. The board holding the dishes is mounted on a revolving pin in the center of the table

was ground with powdered emery on to the steel pin until it turned as smooth as glass, and the two castings almost touched. Three holes for flat head brass screws were drilled in each casting and countersunk. A manila paper washer dipped in oil and coated with a graphitic compound was placed to prevent the taper pin from seizing in the lower bearing, and the castings were screwed to the top and bottom octagons, carefully centered. This was accomplished by means of the small hole previously drilled in the center of both top and bottom, the screw holes being laid out exactly with dividers both on the wood and the castings. The newly-cut edges were then dyed and waxed to agree with the finish of the table and the job was complete.

Replacing Pistons By Simple Means



The task of inserting an automobile piston in its cylinder is quickly accomplished with a rope and a hammer

AUTOMOBILISTS who have had difficulty in getting their pistons back into the cylinders can accomplish the task with ease with a piece of twine and a hammer-handle. The piston-rings being assembled on the piston with the break in the rings spaced equally around the piston, the piston is slipped into the cylinder and pressed inwardly until the first ring engages with the end of the cylinder, checking its further progress.

A piece of twine is then tied to some convenient projection so that it may be drawn close across the end of the cylinder, and it is then wrapped around the piston-ring one turn, and the loose end drawn taut until the ring is compressed to the desired degree. The piston is then struck with the butt end of a hammer-handle, causing it to slip inward, carrying the compression ring into the cylinder, where it will be held. The operation is then repeated with the other rings.

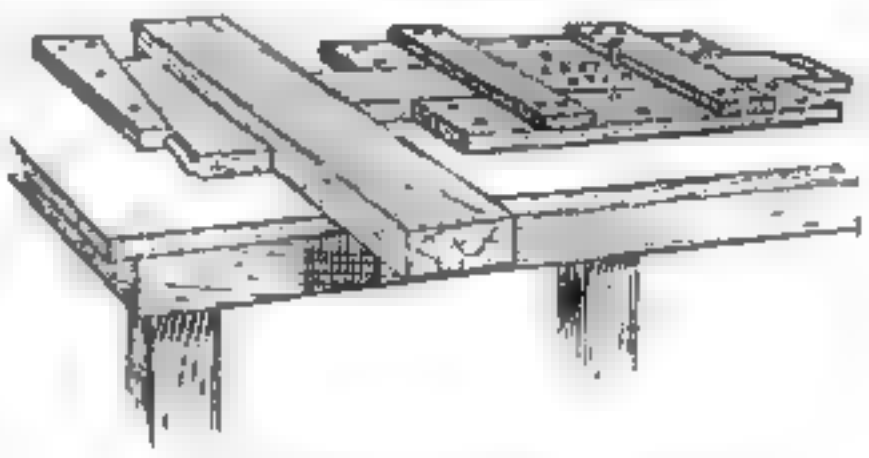
Universal Bench-Stop

A BENCH-STOP that will hold anything and everything a stop could ever be used for; that will hold work from three-eighths of an inch square up to heavy slabs of wood up to twelve inches wide and three and four or more inches thick, edgeways or laid flat; and that will hold any and all of this work perfectly square and without injuring edges and corners and yet hold it in a vise-grip, can be made in less than an hour from a few scraps of inch-board, as follows:

Take two pieces of inch-board 2½ inches wide and 12 inches long and nail them perfectly parallel, planed edges facing each other, to the head of the workbench. Keep them eight, ten, twelve, or more inches away from the edge of the bench, according to the extreme width of the work you plan to use the stop for. Then make another piece of the same thickness, but 18 inches long, and fit it so it will slide snugly between the two pieces. In the center of this piece bore a number of ¼-inch holes, ½ inch apart and ½ inch from the edge, and bore a couple of corresponding holes through the top of the bench, so that a large spike can be inserted and hold the piece in place. Nail a couple of strips crossways on to the two stationary pieces so this sliding piece cannot jump out.

Anywhere from six to twelve inches away from and opposite, and at right angles to it, nail one-half of a wedge made of tongue-and-groove inch-board, groove in, and let it engage with another wedge having a tongue.

A moderate pressure with the thumb against the movable wedge will hold the work in a bull-dog grip and without



A bench-stop that can be quickly adapted to every kind of work

injury, provided sufficient care has been taken to make the edge of the wedge and the end of the slide perfectly square.

By cutting down one end of the slide to a thickness of ⅜ inch and inserting a piece of ⅜-inch board between the wedge and the work, thin boards and strips down to that thickness can be held and planed.

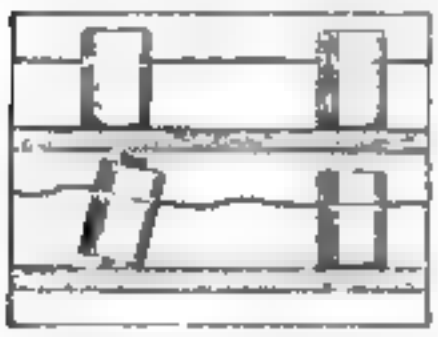
Chick Mash Box

A SHOE, candy, or any cardboard box is all one needs to make a chick mash box that is handy and sanitary, and when dirty can easily be replaced. Cut U-shaped openings in the sides and ends of the box, fill with dry mash and replace the cover. The chicks get at the mash through openings, but cannot get into it. A more durable box can be made of wood.—L. E. FETTER.

The simplest kind of cafeteria

Tightening Wire on Knobs

WHEN using split knobs on open wiring it is sometimes quite difficult to get the wires taut so as to have a presentable appearance.

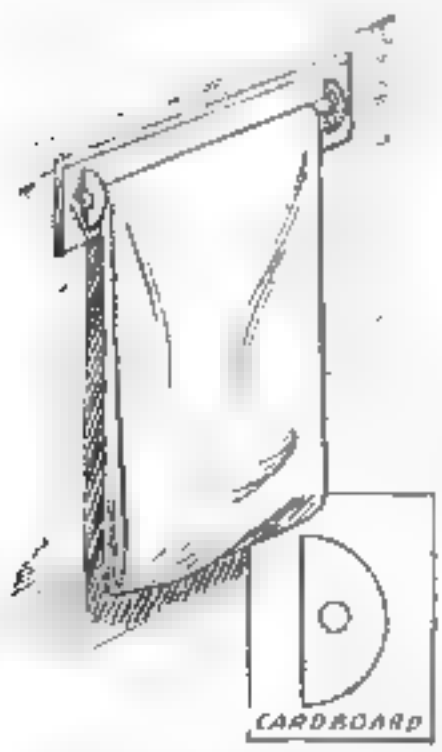


A new way to tighten wires

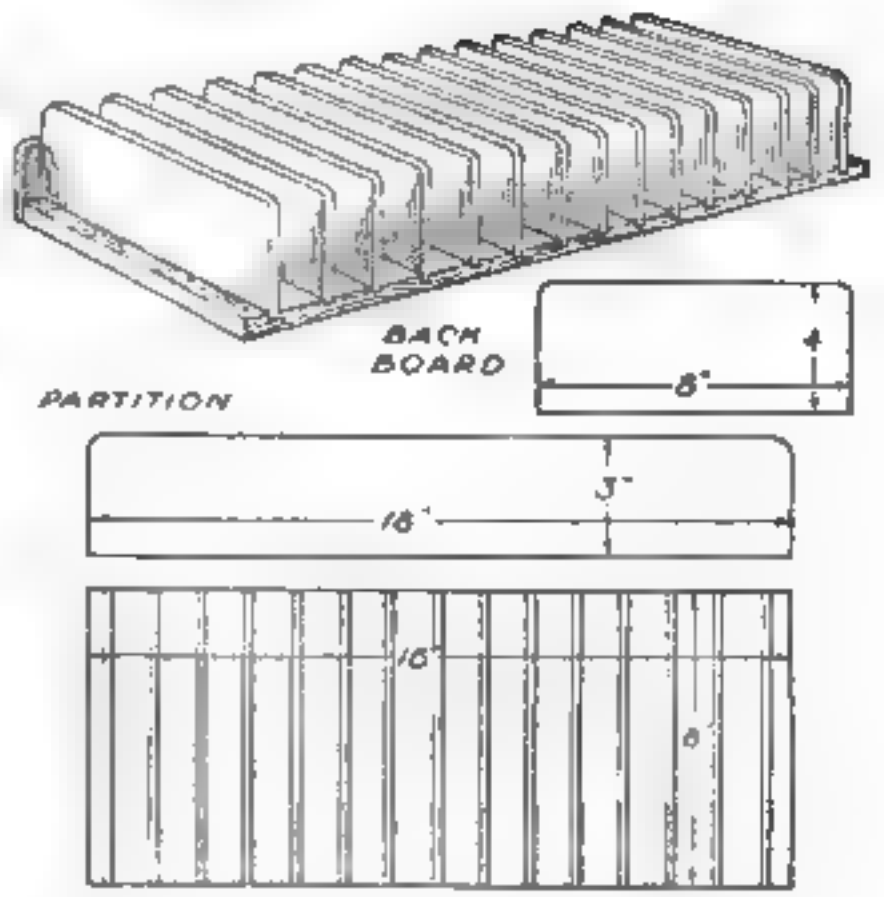
One method of overcoming this is to start the screw with the knob on a slight angle so that when the screw is tightened up it tends to grip the wire and pulls it tight—LOUIS LIND.

Improving a Towel-Roller

AN ordinary towel-roller has no rim or flange to keep the towel from getting caught between the rod and the end-supports. Cut two semi-circular pieces of cardboard, as shown in the illustration. Cut a hole in each at the proper point to bring the straight edge of the cardboard tight against the back of the roller. Fit the pieces of cardboard on the ends of the roller.



The towel will not catch in the ends



The numerous slots can be used for salesmen's data, each man having a division

A Manager's Desk File

A DESK file for managers, which obviates the unnecessary handling of salesmen's data, is shown in the sketch. It consists of a board for a base into which a number of slots are cut to receive division boards in an upright position. The base in this instance is 18 ins. long, 8 ins. wide and ⅞ in. thick, cut and finished from a piece of quarter-sawed oak to match the flat-top desk on which it is placed. The surface of the board is laid off in divisions of 1 in., allowing ¼ in. for the grooves.

The ¼-in. boards forming the division partitions are rounded on both upper corners, and they are cut as long as the base is wide. A back board, cut as long as the base, is fastened to its rear edge to prevent papers from being pushed entirely through the file.

The division boards are cut to fit the grooves snugly, so that one may be removed, if desired, to make a wide space for any special purpose. Of course these can be glued in solidly. Domes are driven into the under side to prevent scratching the surface of the desk.

On the front edge of the baseboard are placed the names of the salesmen, and any matter requiring their attention is slipped into the proper place. This handy little device serves its purpose well in this instance.

Drilling Square Holes

THE drawings relate to work that is drilled in the lathe. The same piece is shown in Figs. 1, 2 and 3, Figs. 1 and 2 showing round and square holes. They are the formers and are used for drilling square holes in round stock, such as would be used for socket-wrenches, etc. Let us say we need an inch-square hole. The stock is put in the lathe chuck and drilled with a one-inch round drill. Then the former (Figs. 1, 2, 3) is slipped over the stock and fastened with the set screw, *C*. This brings the one-inch square, *B*, against the one-inch round drilled hole. The tool, Fig. 5, is then inserted in the back-center of the lathe and fed to the round hole, the three-sided drill, *D*, cutting the hole one inch square.

Fig. 6. Former, to be held in tool post of lathe when drill is running and work is on back center

This is caused by the square in the former going around the drill, and the drill having a play in all directions.

The play of the drill is provided for by the simple means of something like a modified universal joint, *E* and *F*, Figs. 4 and 5, the pin *E* fitting loosely in part *F*. Being rounded, the part *F* has a movement that works two ways and the pin *E* makes the other two movements. Hence we see that this provides for a limited circular movement.

If the work (flat stock or otherwise) is needed to be drilled, the tool (Fig. 4) is inserted in the lathe head, and the tool (Fig. 5) is used in the tool post, the former part *I* being brought up to the work, which is secured by any ordinary means to the back center. The position of the drill in cutting square hole is shown in Figs. 7 and 8. It must be understood that the former must be as close to the work as possible. The former should be hardened and the drill edges slightly rounded.

The cutting end of the drill should be slightly rounded, similar to a reamer edge. Of course the drill has not much work to do—simply taking out the round corners. It can be used in the drill press, the work and former being strapped to the table.—EDGAR HOLDCROFT.

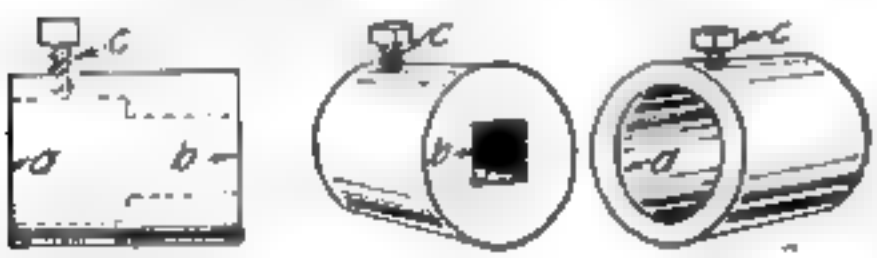


Fig 1 Fig 2 Fig 3

Formers for round stock that is held in lathe chuck

Fig. 4. Drill holder and three-sided drill held in back center

Fig. 5. Same as Fig. 4, but assembled

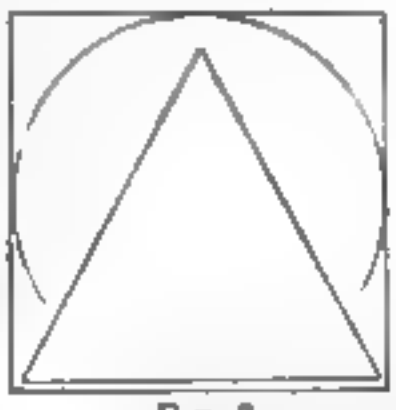


Fig. 7

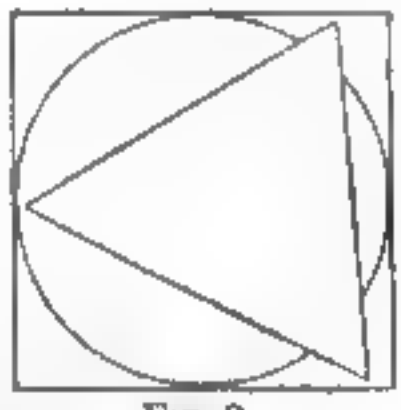
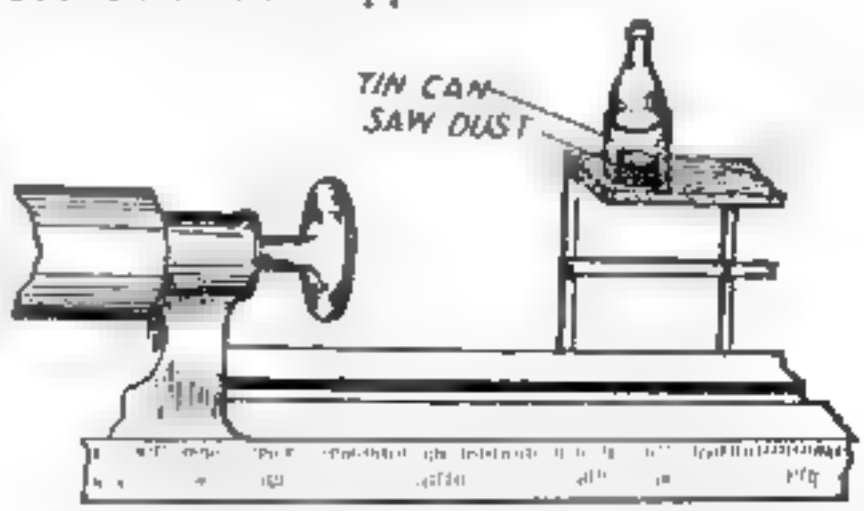


Fig. 8

Showing two positions of three-sided drill about to cut the round hole square

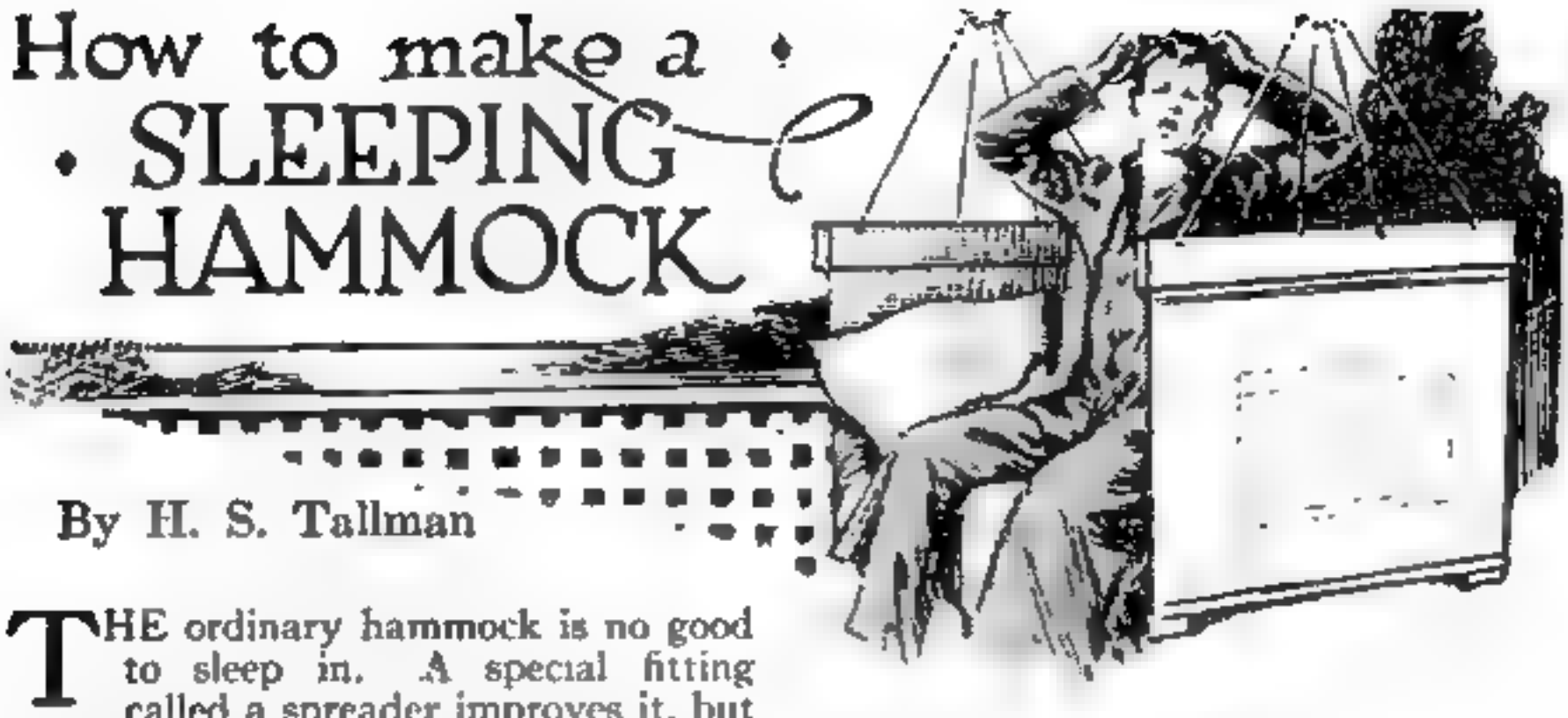
A Remedy for Jarring Bottles

IN order to keep bottles from jarring off a lathe or shelf on the lathe or from being knocked off a shelf which may be remote from the lathe, a tin can is nailed down to the shelf and about 1½ ins. of shavings and sawdust placed in it to keep the bottle from being broken when dropped into it.



The bottle can not slide or jar off

How to make a SLEEPING HAMMOCK



By H. S. Tallman

THE ordinary hammock is no good to sleep in. A special fitting called a spreader improves it, but not enough for real rest. To sleep in absolute comfort, the hammock must support the sleeper without sag. The hammock described does this.

Make a frame of ⅞ in. by 2½ ins. hardwood bars. It should be at least 5 ft. 6 ins. long and 2 ft. 6 ins. wide over the side bars. The end bars are placed on top of the side bars, all of them being laid flat. Bore each junction for a ⅜-in. carriage bolt, and make a fit, but don't put together yet. Cut two braces as shown in cross-section and fit these with ⅜ in. carriage bolts. Bore ½ in. holes as shown in the side bars, and chamfer both sides of the holes, otherwise they might cut the lashings. These holes should be 1 in. from the outer edge of the side bars.

Cut two hanger strips of awning duck, 30 ins. wide and 3 ft. long. Sew these at one end so as to form a pocket into which a 2½-in. by ⅞ in. spreader bar, 30 ins. long can be slipped. See Fig 3. Hem the vertical edges if necessary. It is preferable to have no hems on these edges. Tack the other end to the end bar as shown in detail, Fig. 3, and take a full wrap so that the strained portion of the hanger covers the tacks. Nick the duck at the bolt holes with a pocket-knife, put in place on the side bars, and bolt together securely.

Four ½ in. holes are bored in the spreader bar as shown in Fig. 3. The canvas or duck must be cut out opposite these holes, and buttonhole stitched, to permit threading the 5/16-in. hanger cord. Make a strong knot on one end of the cord, and thread it through the end hole, then through the ring, then the next hole, etc., finishing up with another knot at the last hole. Work the cords and ring until the cords are strained evenly, and lash them firmly together just under the ring.

Pockets of the duck can be sewed to the hanger at one end, for handkerchief, fan, flashlight, etc., if desired. The back curtain is 5 ft. 6 ins. long, and has a heading to pass over a 2-in. by ⅝ in. strip which supports it. Holes in the end of this strip permit tying it to eyelets in the back edge of the hanger. The curtain itself is tied with tape to the hangers and side bar as shown in Fig. 3. This prevents to a great measure, direct draft across the sleeper.

The hammock frame can now be hung by stout ropes or chains from screw-eyes properly placed in the framing of the porch ceiling. They must be so placed that the end hangers are vertical or nearly so.

The stretcher is made of heavy canvas. For a person of average weight, the awning duck might be made to serve, but a heavier grade is preferable. It should be 30 ins. wide, and have a 2-in. hem stitched down with at least two rows of stitching, all the way around. In this doubled material the eyes for lashing are cut and buttonholed with strong cotton twine. They should be located as shown in Fig. 1.

A lashing is then taken with the 5/16-in. cotton cord at each hole in the side bar, five in each bar, and pulled tight, tying the knot so as to be underneath the side bar. The end lashings

are served continuously, reefing round and round the end bar, and tucking the final end under the last loop as shown. This permits of tightening the end tension when necessary. The canvas stretcher must be stout enough to stand

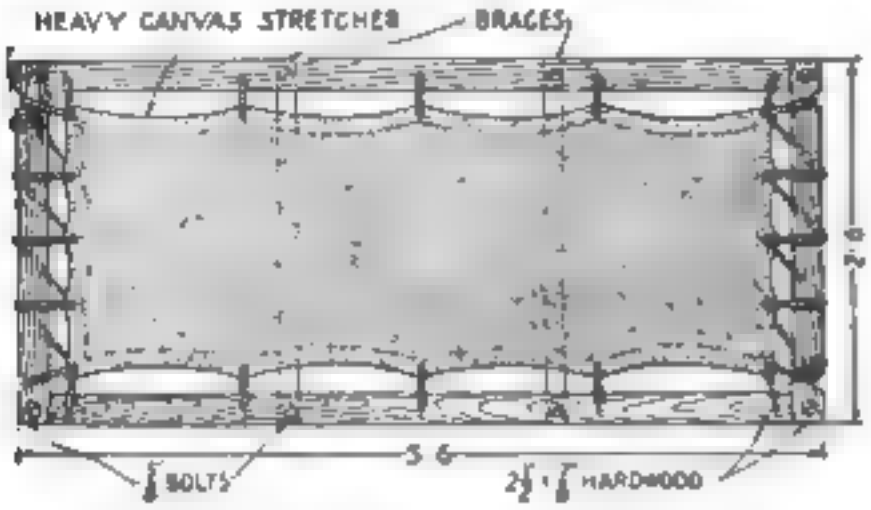


Fig. 1. Diagram showing how the heavy canvas seat is constructed

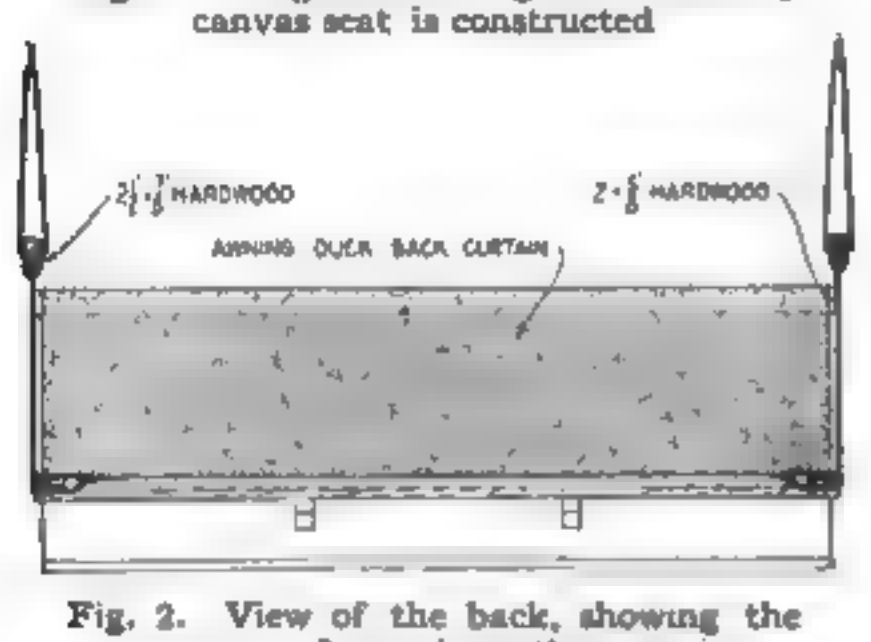


Fig. 2. View of the back, showing the manner of attaching the curtain

for all the purchase a strong man can put on these end lashings. This stretcher takes the place of the ordinary bed spring used indoors.

A mattress about 3 ins. thick is used on this hammock. It can be purchased to fit, or can be made from such materials as common packing excelsior with about 1 in. thickness of common cotton bats on top. It should be well filled and tufted by sewing through and through with heavy twine and an upholsterer's needle, about 8 ins. apart, 3 ins. from the edges, and 8 ins. apart both ways at other points until fully secured. Spanish moss, curled hair or cotton felt can be used if desired. The mattress should be full 30 ins. wide and 5 ft. 6 ins. long.

In hanging this hammock on an open porch, the back curtain should be hung outward to prevent accidental inspection of the sleeper from the open. If used on an enclosed porch, like that described in the June issue, it is delightful at night, and forms a splendid lounging place during the daylight hours. With properly placed porch awnings, which can be lowered into position, sleeping on the porch, even on a rainy night, is quite possible and entirely comfortable.

Hammocks similar to this in many respects, provided with steel springs and mattress, can be purchased in the market. They are rather expensive, due to their liability to deteriorate from exposure in a damp atmosphere. In an emergency, or a very severe storm, it is only necessary to carry the mattress of this hammock to a sheltered place. The rest of the outfit will not suffer from a drenching, and will dry out quickly as soon as the weather clears. Having once tasted the delight of open air sleep, it will be a matter of regret when the advent of winter compels a change to indoors.

The entire hammock equipment can be taken apart and carried by campers. Its weight is not prohibitive providing the campers have a wagon. In a country where trails take the place of roads and packing horses the place of wagons the hammock could not be utilized. Under such conditions it would indeed be a luxury.

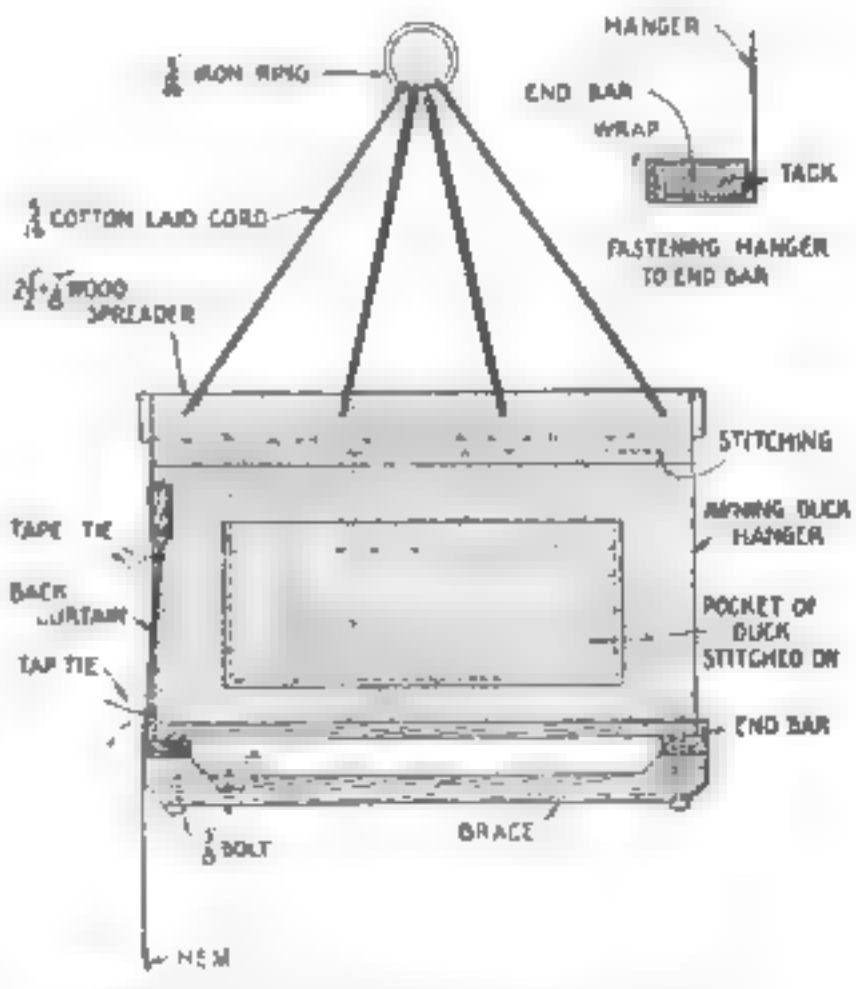


Fig. 3. One end of the swing. Note the strong under-brace and end bar

Determining Brake Horsepower

THE brake horsepower of an engine or motor is often determined by means of a friction or proney brake Make two wooden blocks *A* and *B* to fit the face of the pulley on the machine to be tested. The pieces *C* and *D* are fastened to the two blocks and the whole clamped together by means of the two bolts *E* and *F* with the nuts *G* and *H* to tighten or loosen the whole. The end of the arm *D* has an iron eye in it to hook to the spring balance *J* which is hung from some suitable support. When the pulley is revolving in the direction indicated at its best speed the nuts *G* and *H* are gradually tightened until the friction is increased on the pulley and the arm pulls downward with considerable force. This tendency to turn will be indicated upon the spring balance.

The net pull at the balance is obtained by subtracting the net stationary weight of the arm from the indicated weight at the balance when the test is made. This distance is represented as *N*. The correct speed of the pulley or revolutions per minute must also be known. After all this data has been obtained the brake horsepower of the machine can be calculated by the following formula:

$$\text{Brake Horsepower: } \frac{2\pi \text{ N W RPM}}{33{,}000}$$

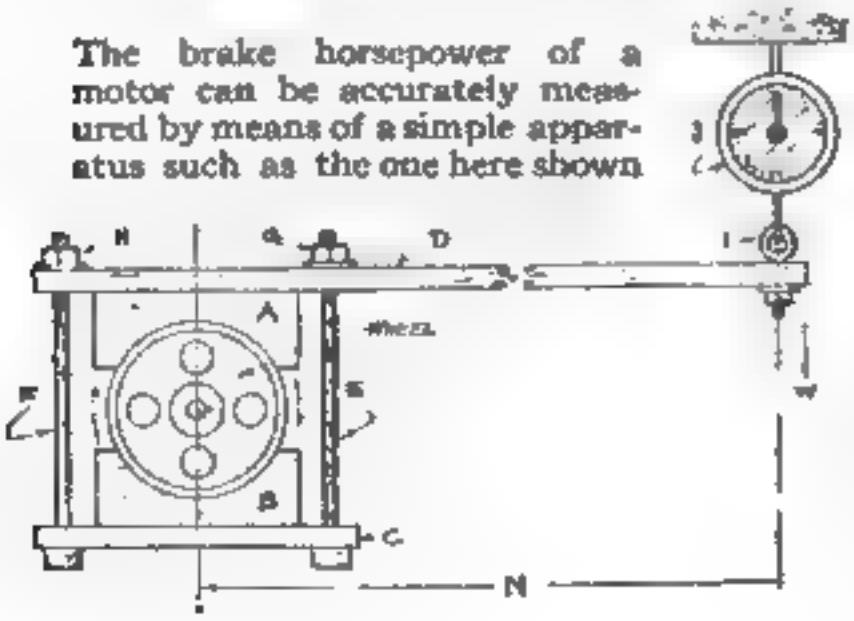
π . 3.1416

N . Length of arm in feet.

W . Net pull, in pounds, at the spring balance.

RPM. Pulley speed.

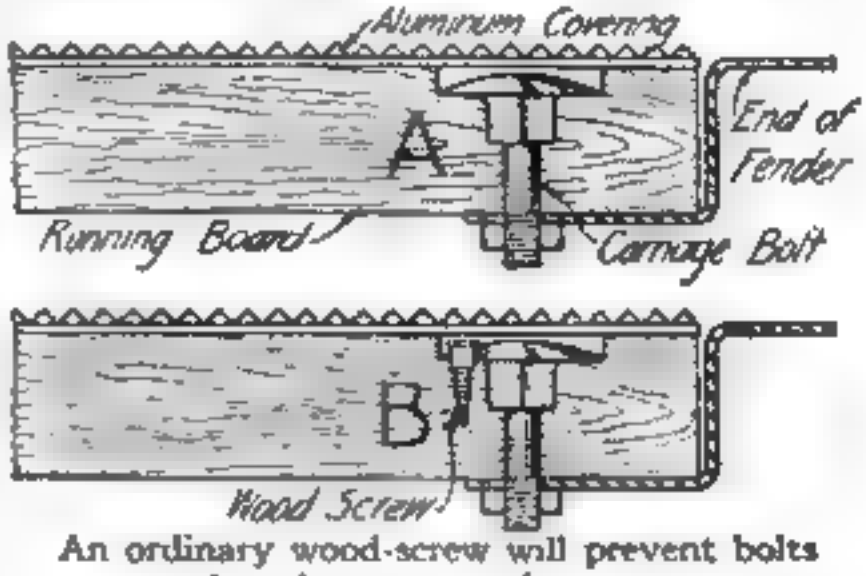
This method, simple as it is, will be found of great service in determining, accurately, the brake horsepower of a motor or engine.—B. F. DASHIELL.



The brake horsepower of a motor can be accurately measured by means of a simple apparatus such as the one here shown

Preventing Carriage Bolts from Turning

CARRIAGE bolts are generally used in fastening sheet-metal parts such as dust-aprons, mud-guards, etc., to automobile running-boards. While these

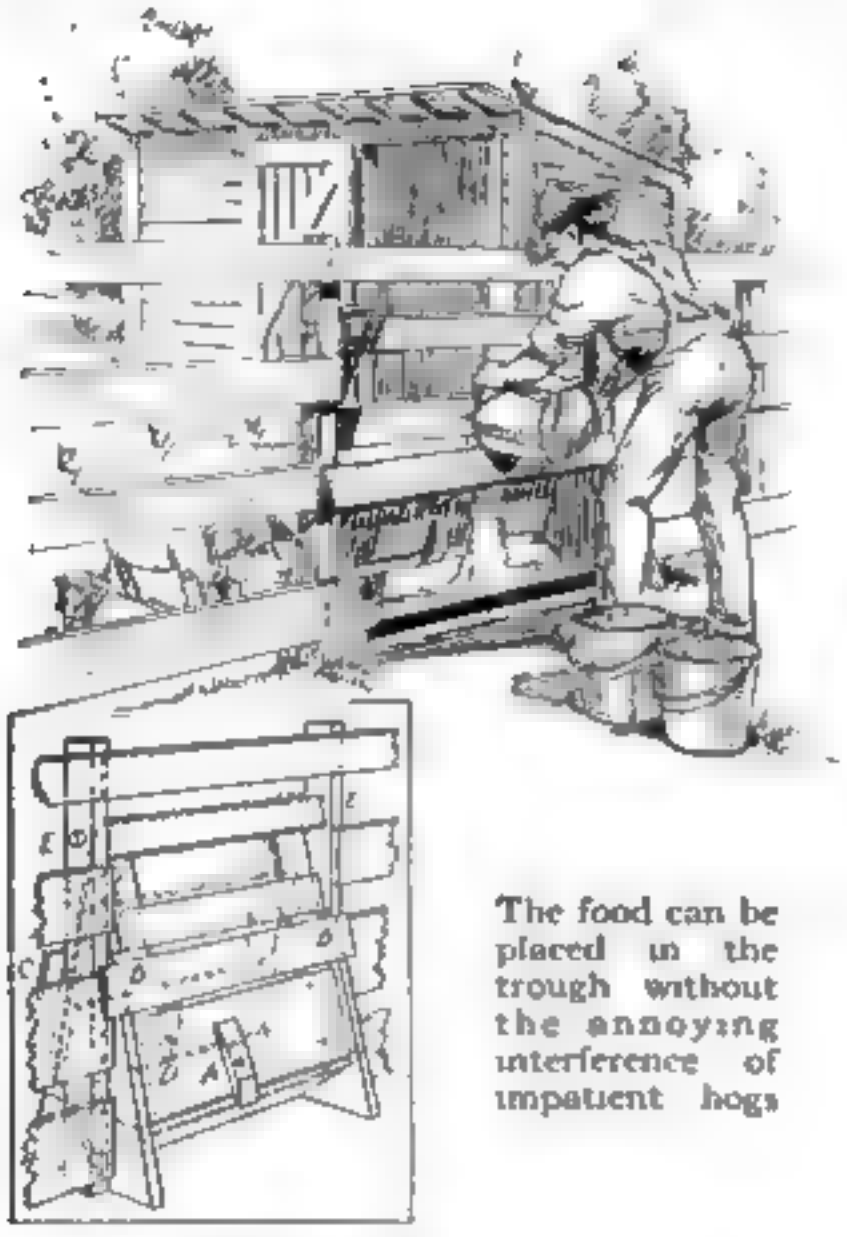


An ordinary wood-screw will prevent bolts from loosening and turning

have a square shank to prevent them from turning in the wood, if the running-board is of soft material the bolts are liable to cut away the wood surrounding the square shank and make it difficult to either remove or apply the nut. This is not a serious matter if the bolt head is exposed so it can be held by wedging, or if it has been provided with a screw-driver slot before assembling. When the running-board is covered with linoleum, which is nearly always shellacked in place, or aluminum matting, which is held by small screws and binding-strips, it is difficult to get at the bolt head. The usual installation, shown at *A*, can be improved materially by following the scheme shown at *B*. This can also be used if the bolt has been installed and the square shank has turned. A 1/8-in. or 5/32-in. drill hole is made in the bolt head and a suitable wood-screw inserted and firmly set into the wood, as at *B*. This is insurance against the head turning and prevents an upward movement of the bolt when an attempt is made to screw on the nut.—VICTOR W. PAGÉ.

A Celluloid Flashlight

WHEN a ruby light is not available for developing photographic prints an ordinary flashlight will serve the purpose. Remove the lens and fit a disk of red celluloid in its place. Turn on the light and the celluloid will redden it, protecting the negatives from direct light.—C. H. MILLER.



The food can be placed in the trough without the annoying interference of impatient hogs

Improving the Hog's Table Manners

MORE attention is given to the care and feeding of hogs than ever before, but while the composition of the rations has been improved, there has been no breed of hogs developed even among the aristocratic prize winners, whose table manners are essentially different from those of the plebeian.

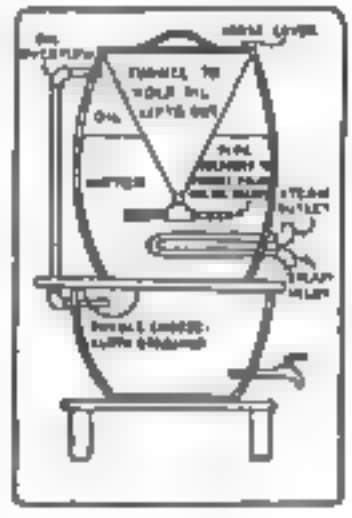
If the hogs could not reach the trough until the food had been poured into it and evenly distributed, the feeding process would be simplified. This may be accomplished by applying the method suggested by the accompanying illustration, in which it will be seen that a section of the fence is cut out to receive the trough and gate. The latter, swinging from the top at *E*, is held at the inside edge of the trough by the button *D*, as indicated by the dotted lines, which permits the feed to be poured into it.

The bottom of the gate may then be swung outward and held in place at the outer edge of the trough by the button at *A*, as shown by the full lines, which will allow the hogs to reach their feed.

The stops *B*, *B*, upon the outside of the fence, and *C*, upon the inside, prevent the gate from being opened.

How to Make an Oil-Filter

A SIMPLE oil-reclaiming outfit may be made from a whole barrel and a half barrel. A funnel, terminating in a perforated pipe, is attached to the rim of the whole barrel as shown in this illustration. Water is placed in the upper compartment. If the filter is used where a stream of hot water or steam can be utilized, it will improve the action of the filter. In that case, place a loop of the pipe in the side of the barrel and keep the temperature of the water near the boiling point.

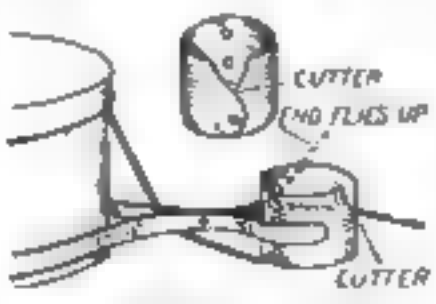


When the oil rises to the top of the barrel it overflows through the pipe at the left into the part below, where it passes through a strainer made of two thicknesses of cheesecloth. The complete outfit can be enclosed neatly and compactly in an outer covering of boards to represent a cupboard.

The oil reclaimed by this filter is good enough for all ordinary speed shafts or bearings. Accessories, such as a water overflow and draw-off valve, etc., for the top barrel, will suggest themselves to anyone sufficiently interested to construct a filter.—JAMES E. NOBLE.

String Holder and Cutter

A NOVEL device in the shape of a convenient holder and cutter for a ball of cord is here illustrated. The cutter is made in the shape of a sheet-metal collar with partly overlapping ends, these being sharpened so as to cut the cord. The cord is brought through a pair of holes in the cutter so that after the cord is cut the loose end tends to fly up, owing to the elasticity of the string. The end then lies above the cutter where it can be easily grasped. The cutter piece is attached to the string box by a pair of sheet-metal arms.

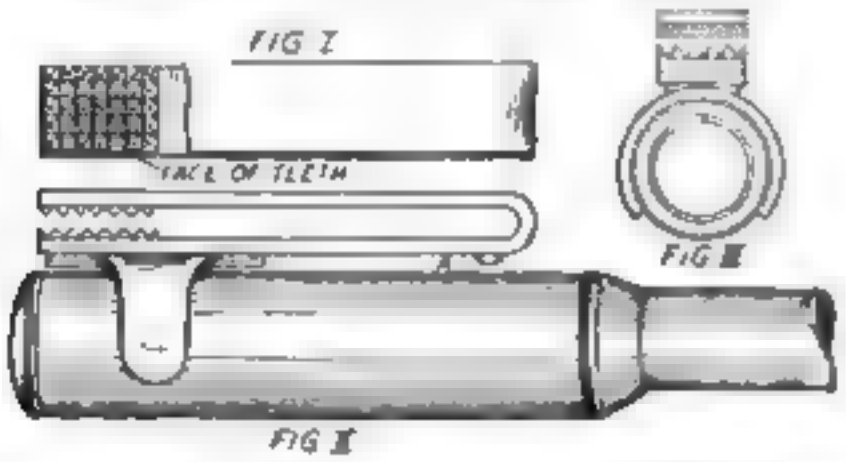


For holding and cutting twine

Convenient Check Protector

THIS device is valuable to persons who are required to write checks where a check-writing or protecting machine is out of the question. The principal advantage of this device is its compactness, inasmuch as it can take the place of the ordinary pen clip, thereby serving two purposes and always being at hand when required.

It consists of a piece of spring sheet-brass, ⅜ in. wide and 4 ins. long, bent to the shape of a long U (as shown in the illustration). A set of teeth (made out of brass or steel) is soldered on to the ends of the U-shaped spring (as shown in Fig. II), but the greatest care must be taken to insure the perfect meshing of



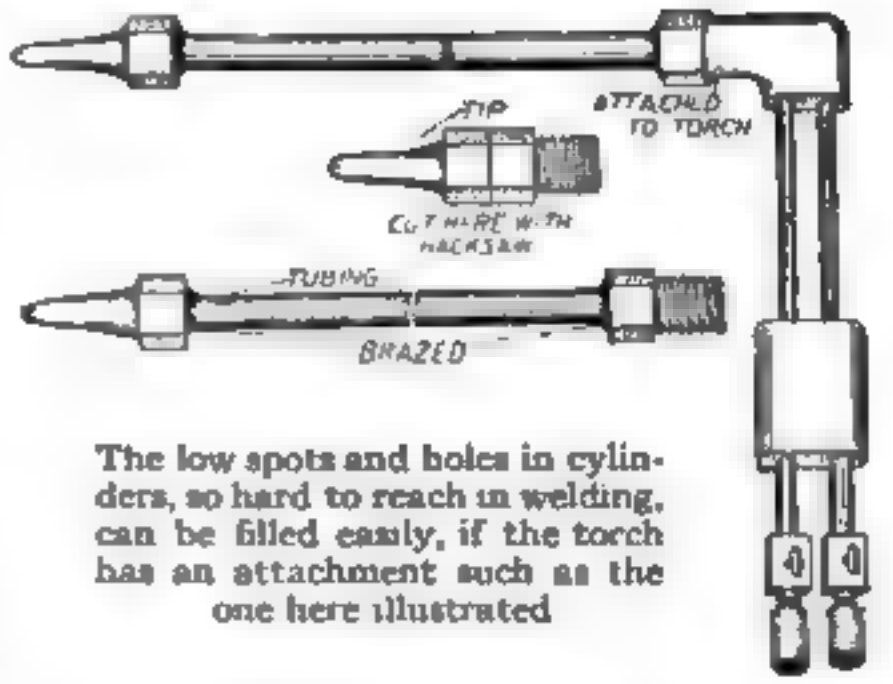
A check protector, a pen for writing the check, and a clip for holding the pen, all combined in one instrument

one set with the other; else the device will not work efficiently. The teeth should crimp and slightly perforate the paper. A drop of solder placed on the free end of the spring (as shown at *A* in Fig. II) enables one to slip it over the edge of the pocket and prevents the pen from falling out.

After filling out the check, place it between the jaws of the protector, with a portion of the lettering to be protected between the teeth. Exert a slight pressure with the thumb and then allow the spring to open. Slide the device along to another portion and keep repeating this operation until the whole amount to be protected is covered, thus making it impossible for anyone to tamper with the check without being detected.

Attachment for Oxy-Acetylene Torch

THIS attachment is for a welder in filling low spots and holes in cylinders where it is impossible to get in with



The low spots and holes in cylinders, so hard to reach in welding, can be filled easily, if the torch has an attachment such as the one here illustrated

the torch. It is made of ¼-in. heavy copper tubing. Obtain a tip of the size desired for the job and cut in half at the hexagon part. Then braze the tubing to the bushing part of the tip. Also braze the other end of the tubing to the other part of the tip. Anneal the tubing so that it will bend to suit the particular task in hand. This will work on all sizes of tips.—H. P. ALLMARAS.

Turning on Lathe with Calipers

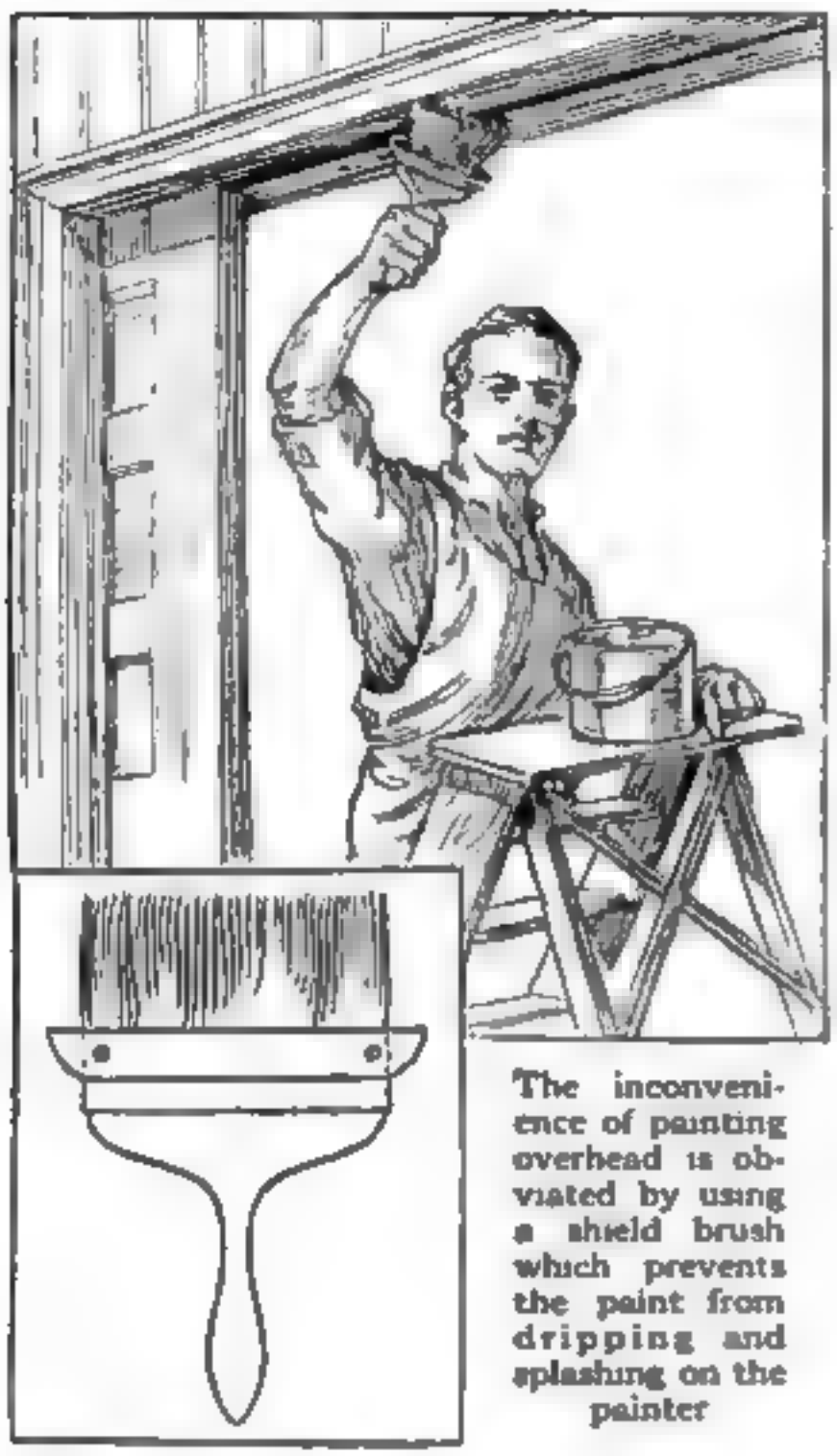
TO use calipers when turning small or medium-sized work set them at the size of the piece to be turned down, and then after going over it roughly take a small, flat chisel in one hand. Hold the chisel over the rest against the wood and the calipers in the other hand over the revolving wood so as to size it by holding one side of the calipers against the chisel, sliding it back and forth on the chisel to allow the shavings to work off.

Calipers give accuracy in turning small pieces

This is a slow way, but a safe and sure one for accurate work.—W. F. GOOT.

Starting Your Automobile with Ether

TO start an obstinate automobile engine, purchase some ether in a paint store and prime your engine with it. Turn the engine over once or twice with the spark-switch off and then throw on your spark. With a half turn of the crank the motor will start.



The inconvenience of painting overhead is obviated by using a shield brush which prevents the paint from dripping and splashing on the painter

Protecting the Painter from Paint

WHEN it is necessary to paint a window or any object overhead the paint or liquid usually runs off the handle of the brush and then over the worker's hands. If you will take two pieces of tin soldered at the ends, and tack them on either side of the brush below the bristles, you will have a little cup which catches this overflow paint. Each time the brush is dipped into the paint-can the shield is automatically emptied.—C. H. THOMAS.

Uses for Wire-Glass on the Farm

THERE are many places in and about the farm buildings where a stout, tough glass can be used to advantage. Wire-glass answers the purpose.

It is exceedingly strong, resists high winds, hail storms, and is an acknowledged protection against fire. Imbedded within the body of the glass is a meshed wire made of iron which has a higher fusing point than glass. When glass is exposed to fire it becomes more or less plastic. Ordinary glass will crack, bend or shatter. With wire-glass the mesh which acts as a skeleton holds it in place. Even if the glass cracks, the pieces are prevented from falling, and sparks will not find an entrance.

When made wire-glass is poured over a red-hot iron table to the desired thickness. Red-hot woven wire-netting is then fed out from a machine, rolled, and pressed into this glass surface. The surface is smoothed or corrugated, according to the finish desired. It is then annealed to give it high resisting qualities. Wire-glass has the further advantage of not being readily affected by vibrations, and its great strength enables it to hold up unusual weights of snow and ice.

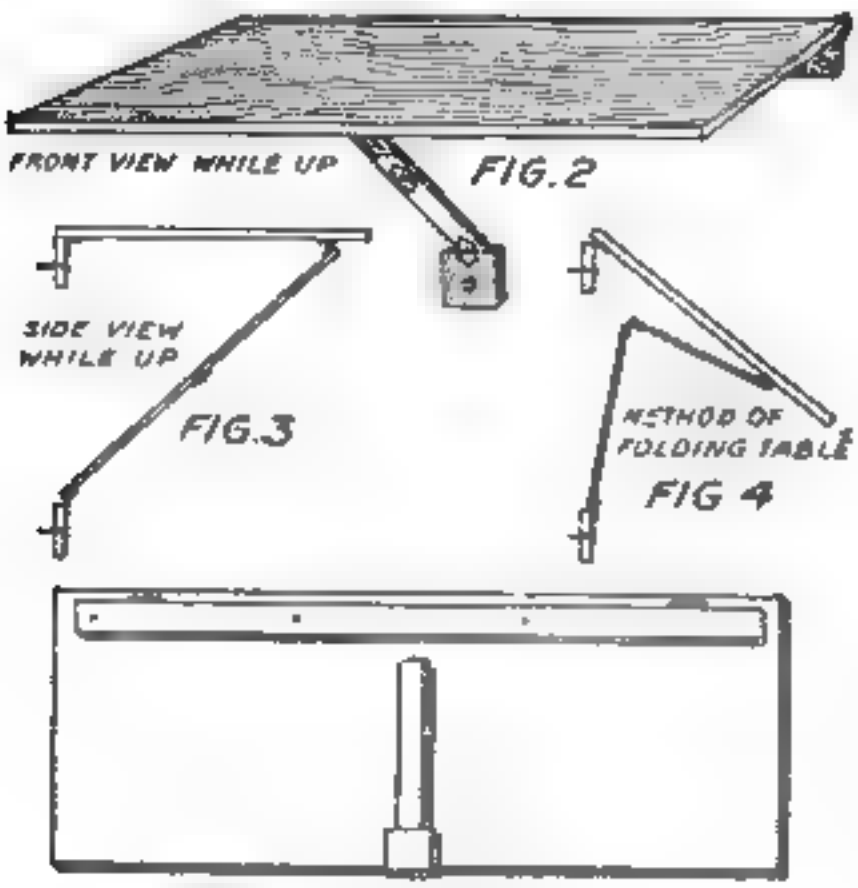
Many buildings on the farm would be improved by more light, but an ordinary pane of glass would not be strong enough. Here wire-glass can be used to advantage, giving more light from the roof or sides of the chicken-house, stable, or barn.

The farmhouse attic is often a dark, inaccessible place, which, if properly lighted, would serve as a valuable storeroom or a delightful playhouse for the children in stormy weather. Here wire-glass can be used for skylights or partitions.—E. G. WALLACE.

A tobacco or coffee can when cut and bent into the proper shape, makes a useful scoop with an old paint-brush handle

A Home-Made Scoop

A HANDY little scoop may be made by trimming an empty tobacco or vegetable can to the shape in the drawing. To make the handle, take an old paint-brush, cut its handle off, and screw it to the bottom of the can with a round-headed screw and nut.



In a small kitchen, a folding table is the best for varied uses

Handy Folding Kitchen Tables

A FOLDING table which is firm and stationary when in use and which takes up no space in the room when not in use can be constructed by any one with available lumber and accessories. The table folds against the wall when not in use, and for this reason it is a great help in small bedrooms, where there is need for a table to hold instruments and medicines. It can be used as a writing desk or a dining table. Its chief value lies in the fact that it folds against the wall and thus takes up a minimum of space.

To Repeat Drawings

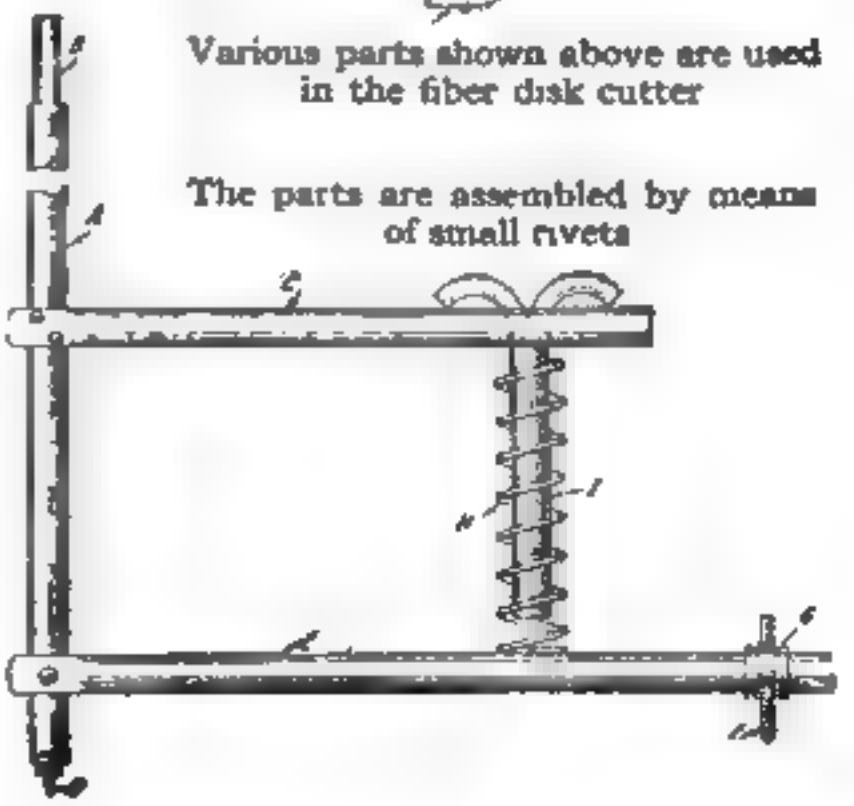
IT often happens that an artist has a design to repeat several times. Here's a quick way. Take a sheet of thin transparent celluloid and sandpaper one side to a ground glass-like surface. Place this over the design and trace the design with lead pencil on this roughened surface. Now turn this tracing down and rub the smooth side of the celluloid with the bowl of a spoon or similar smooth object. Several impressions may be made. With a little practice six impressions are easy to make. Use celluloid such as is in windows of auto-tops. It is very cheap, and the thinner the better.—ROBT. C. KNOX.

Fiber Disk Cutter

SECURE two pieces of ¼-in. iron pipe 8 ins. long. In both ends of one of these pieces tap out ⅛ in. iron thread. In one end screw a short ⅛-in. iron nipple. This is for brace or lathe chuck. In the other end screw in a pointed plug of steel. Split the other 8-in. piece with a hacksaw (one end only), for about 1½ ins. Open this up large enough to slip over ¼ in. pipe. Drill the split end for fair-sized rivet or bolt ½ in. back from end. Drill the other 8-in. piece for this same rivet about 1½ ins. from pointed end. Two ins. up from this point drill two smaller rivet holes as shown in the drawing. These are for a 6-in. piece of ¼-in. pipe to be slotted as you have done with one of the 8-in. pieces. Rivet this securely. Near the end of this 6-in. piece cut an opening to receive a short piece of No. 4 wire. This is the spring guide shown in the sketch. *L* is a slip collar. *M* is a cutting point held in place by *N*, a set screw. *K* is a set screw for holding collar to shaft. *J* shows the method of fastening the 8-in. piece to main shaft *A*. *Q* shows the slot for *I* or spring guide. *P* and *O* shows the fastening for *I* to *C*.

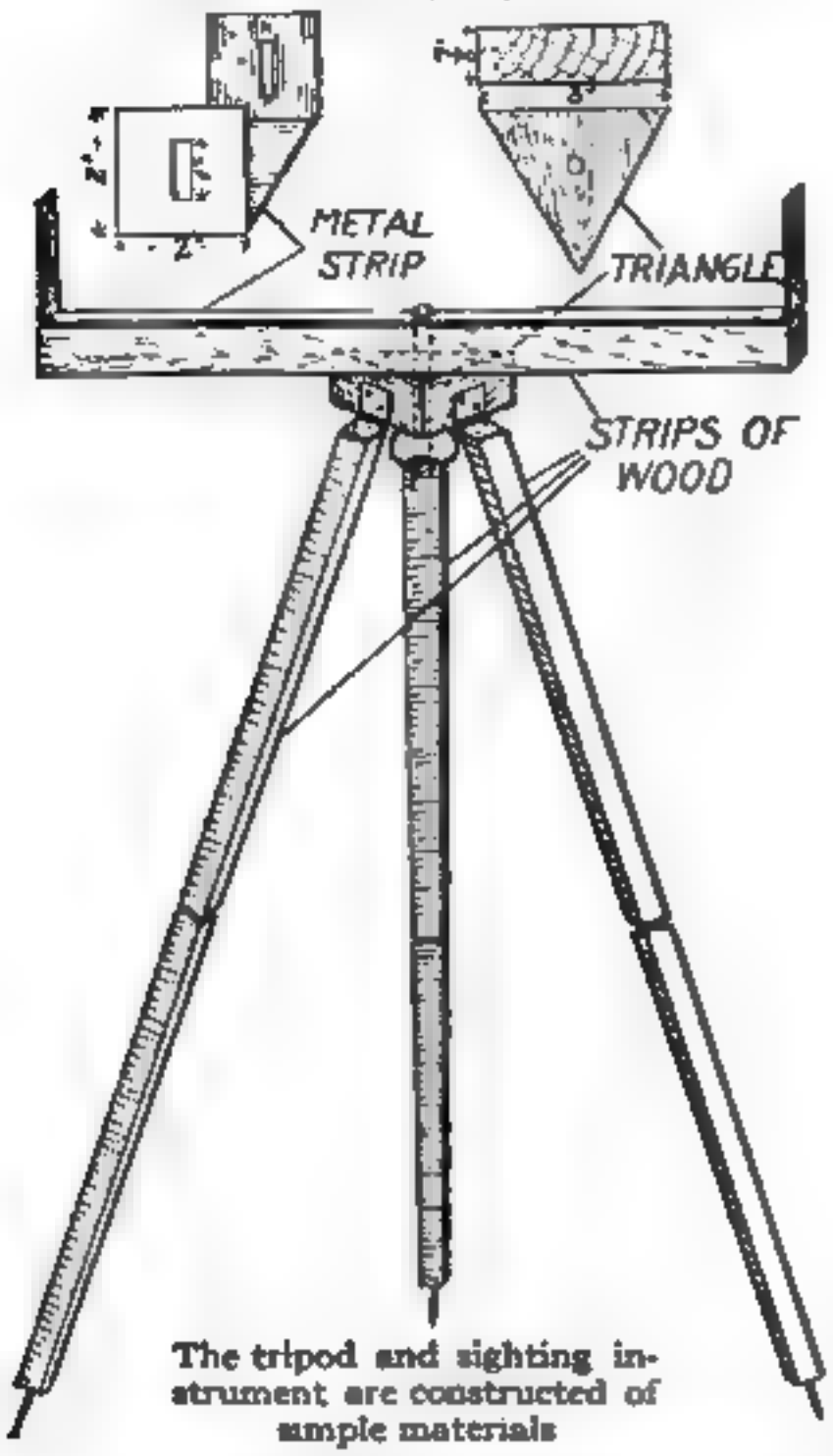
This hinged joint at *E* and *A*, and spring *H* overcomes the difficulty when cutting with brace.

Various parts shown above are used in the fiber disk cutter



The parts are assembled by means of small rivets

A Cheap Surveying Instrument



The tripod and sighting instrument are constructed of simple materials

TO make a practical surveying instrument, take a piece of tin or sheet-iron two ins. wide and sixteen ins. long; a piece of 7-8 in. wood shaped like a triangle, three ins. on a side; three strips of wood as long as the distance from the ground to a little above your eyes when you are standing erect; one lath one foot long; and a wing-bolt.

Bend up the strip of metal two ins. from each end so as to form right angles. Beginning ½ in. from the top of the bent portions and extending to ½ in. of the bottom, cut a slit ¼ in. wide to sight through. Screw or nail the metal strip to the short lath. Drill a hole in the middle of this apparatus to correspond with the size of the wing-bolt, and one in the center of the triangle.

Now make a tripod by hinging one of the three long strips to each side of the triangle. Put a nail, with the head filed off, in the bottom of each leg to form three anchoring points.

To Re-Silver Old Mirrors

FIRST take off all the old silver by the use of nitric acid. Rinse with clear water and wipe off edges with a cloth. Polish the surface of the side of the glass to be silvered with rouge, so as to remove grease and any foreign matter. Then clean the rouged surface off with a brush and a solution of chloride of tin and water.

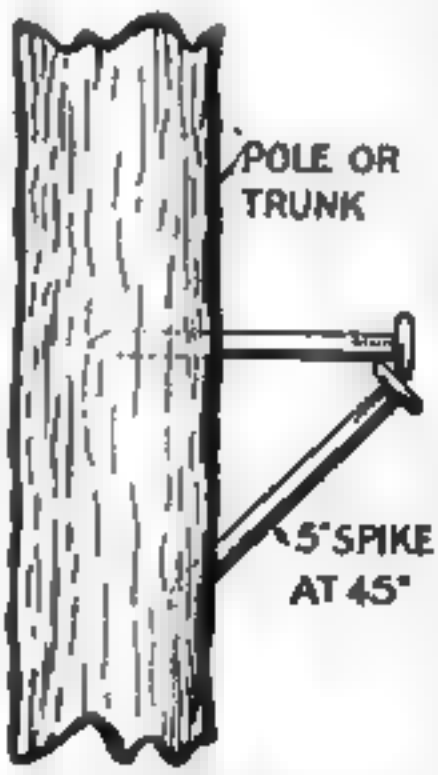
After cleaning thoroughly rinse with clear water and lay glass on a flat table that is level, being careful not to touch the surface.

Next make a solution of ½ oz. silver nitrate precipitate in ammonia with 8 ozs. of distilled water. Dilute ½ oz. of Rochelle salts in 8 ozs. of distilled water.

After these solutions are made and the glass cleaned and ready for the silver, take about 8 drahms of silver solution and 6 drahms of salts, mix, and pour same on glass with enough distilled water to flood the glass. Within three hours the glass will be resilvered.

Temporary Pole-Steps of Spikes

THE wireless amateur interested in outside aerials for his wireless equipment will soon find a demand for safe and substantial pole-steps on which he can climb Nature's antenna poles—the trees. Usually he drives in a nail at some close angle. But this is very unsafe, as he may loose his footing when he least expects it. In the method illustrated two 5-in. spikes are used in making each pole-step, one spike being driven at a horizontal line, and the other directly beneath it at an angle of 45 degrees. The one at 45 degrees is driven in first, and then the straight one. The horizontal step has a tendency to depress the one on which it rests, and results in the former being driven deeper into the pole or tree trunk.



Heavy spikes make serviceable steps

How to Keep Rope from Raveling

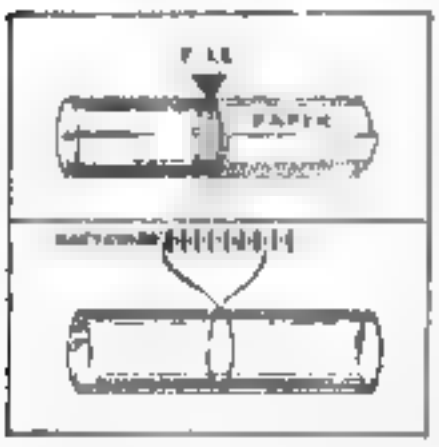
TAKE a piece of gas pipe about 1 in. long and just large enough to slip over the end of the rope and pull the rope through the length of the pipe. This is to get a firm end in the pipe. Cut off the surplus and then screw a stout screw hook into the center of the rope inside the pipe. This will expand the rope so that it is impossible to pull it out. By substituting a common 1-in. screw for the screw hook a rope end can be kept from raveling.

A short length of pipe and a screw prevent rope raveling

—JACK MILLER.

Cutting Glass-Tubing by Electricity

TO cut glass-tubing of large diameter without breaking it, the following simple method is used. With a three-cornered file, make a deep scratch completely around the tube. To have the two ends of the scratch meet and to have a square end after cutting, wrap a narrow strip of paper with parallel sides around the tube and then draw file along the edge of the paper. Take a short piece of iron wire about No. 14 or smaller, and wind it once about the tube, so that it falls within the groove. Fasten one end of the wire to the terminal of a storage battery and with the other end connect in series just enough cells to furnish current to heat the wire to redness. The sudden heating of the wire coming in contact with the cool surface breaks the glass along the scratch and with a little care even an inexperienced person may do efficient work.—W. A. SHEWHART.



Making a neat cut

Smoothing Cross-Grained Wood

REMOVE the cap (curling iron) from a smoothing-plane. File the edge off squarely until it is 1/32 in. thick, instead of being sharp, as originally made. Replace the cap and set it very close to the cutting edge of the bit. This simple expedient will enable you to smooth any cross-grained wood or any wood against the grain, provided it is dry.—WM. C. TURTLE.

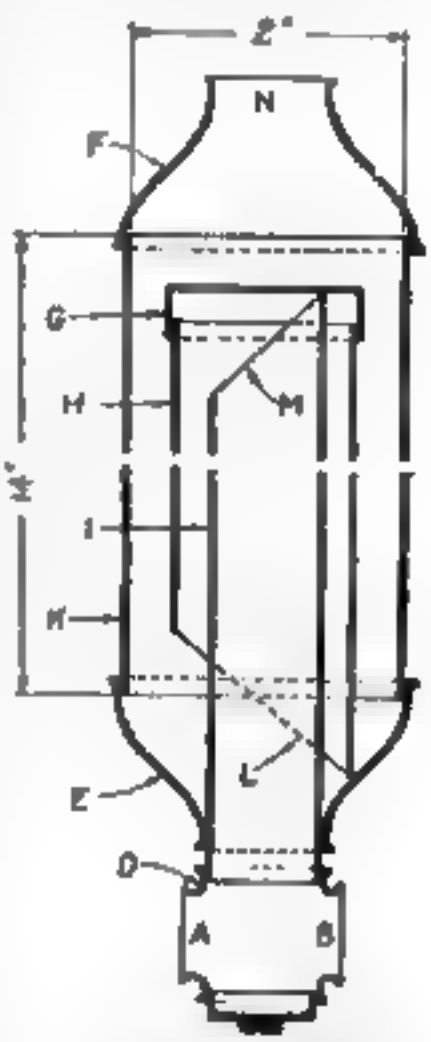
Regulating Shower-Bath Water

THE use of a water-mixer will prevent the annoying spurts of hot or cold water which often occur in shower-baths. Its cost should not exceed seventy-five cents or one dollar.

D is a cross ¾ in. by ¾ in. by ½ in. by ½ in. Hot and cold water enter at *A* and *B*. *E* and *F* are 2-in. by ¾-in. couplings.

K is a 2-in. iron pipe.

I is a piece of ¾ in. iron pipe, cut on a slant, as at *M*. It is screwed through the coupling *E* and into the cross end. *H* is a 1¼-in. iron pipe, one end capped at *G*, the other end cut on a slant at *L*. It is simply placed over pipe *I*. The outlet of the mixed water is at *N*. If it is desired to use steam and cold water the hot water inlet is plugged, the plug *C* removed, and the steam pipe connected there. The mixer is made throughout with ordinary iron pipe and threaded fittings. In actual use it is impossible for the water to be either too hot or too cold if the mixer is regulated as it should be. To insure efficient service the mixer should be cleaned occasionally, preferably once in three months. This can be easily done by taking the apparatus apart.—JAMES E. NOBLE.

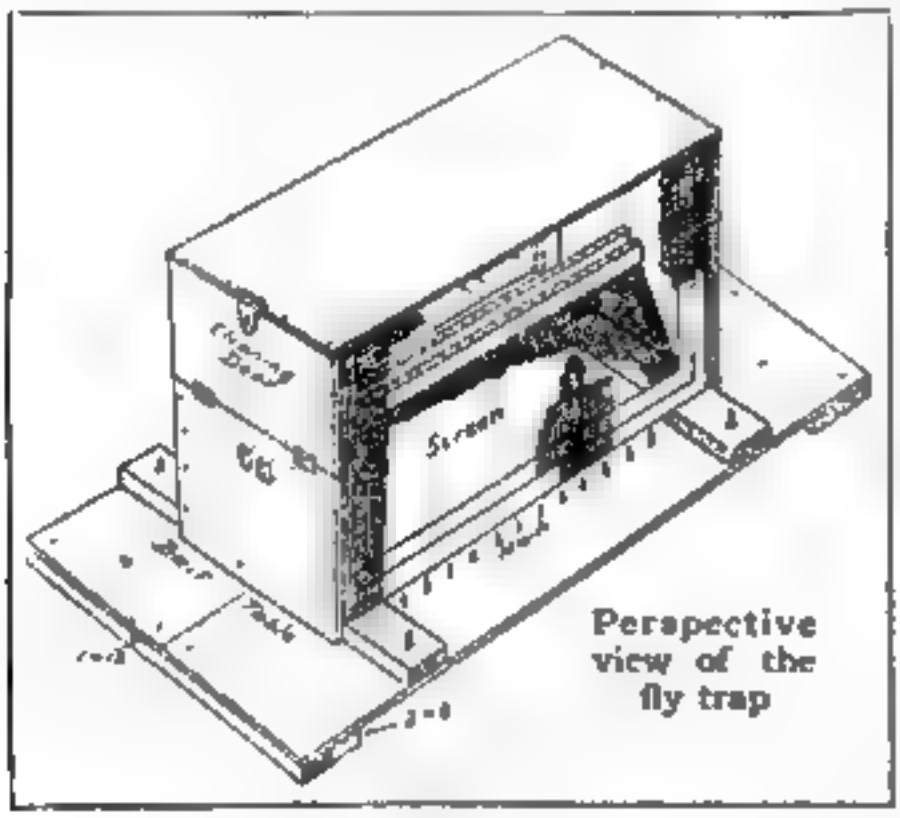


For regulating a shower-bath

An Easily Constructed Fly-Trap

A TYPE of fly-trap of substantial design which will "stand the racket," has been successfully used in the sanitary department of a coal mining company. The illustration indicates the dimensions that have proved desirable.

The operation of the trap is as follows: The flies are attracted by the bait on the bait-platform and pass between the nails to the chamber under the fly box.



Perspective view of the fly trap

They eat their fill and then fly upward into the wire screen funnel and pass from it into the box. They are attracted by the light entering at the sides of the box and but few of them attempt to pass out through the funnel. The ceiling of such a fly-trap can be painted white and the bait platform a dark color, so that after feeding on the bait the fly, following its tendency to move toward the light, will more readily pass up through the funnel.

The feature of the device shown above lies in the fact that the orifice through which the flies enter from the feeding platform into the trap is a long slot through which many flies can pass at the same time. A long orifice of this type is much better than one which is merely a hole of small diameter through which only one fly can pass at a time. A perspective view of the trap is shown above and the drawing opposite reveals the details of construction. The bait platform is built from two planks 1 in. by 12 ins. nailed to two cleats 2 ins. by 4 ins. Through this bait platform, under the position that is to be ultimately

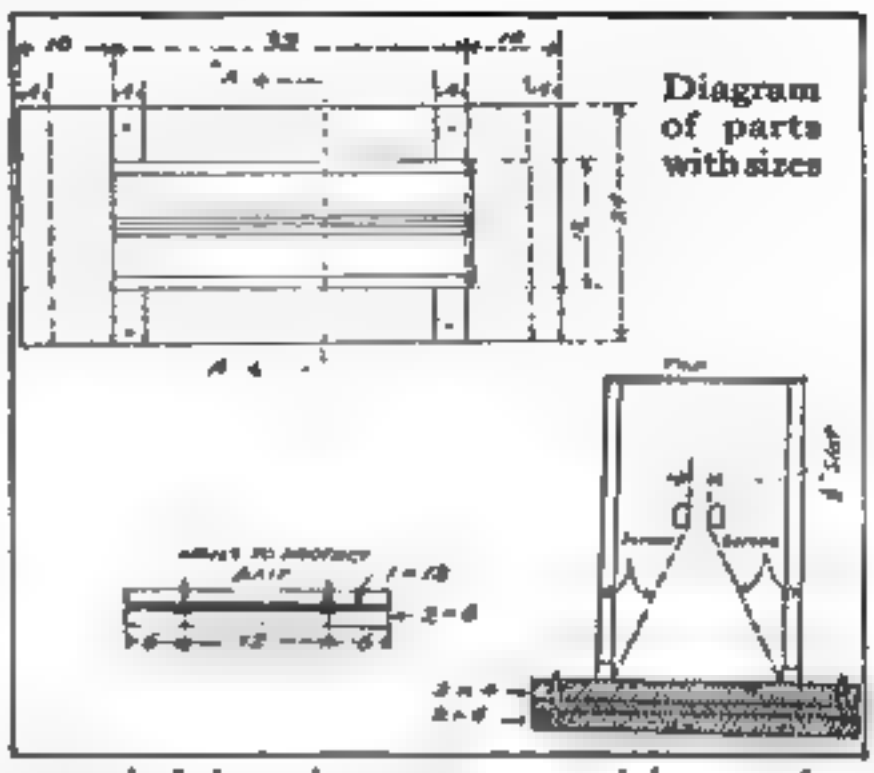


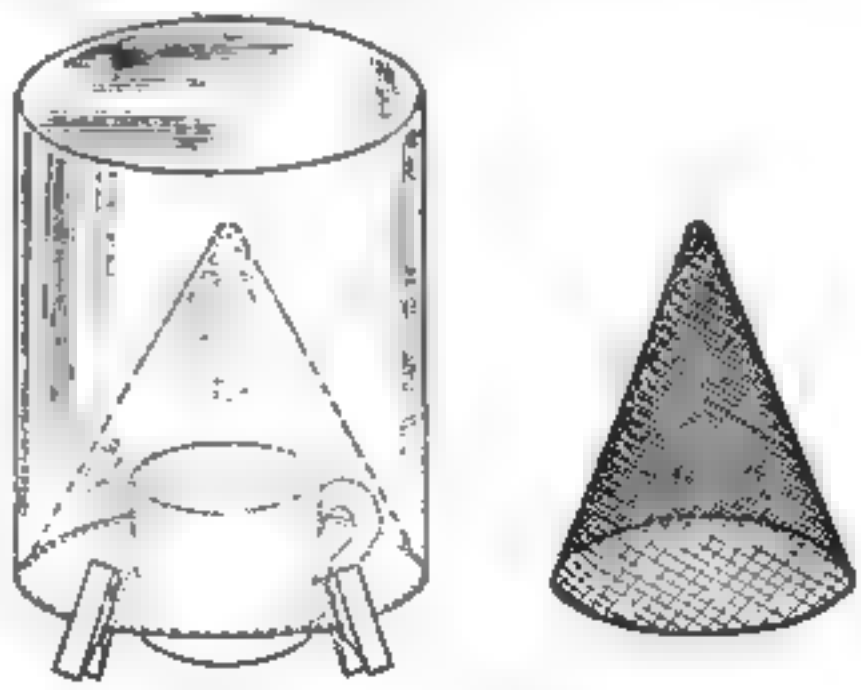
Diagram of parts with sizes

occupied by the trap, are driven wire nails as shown, to retain the bait in position.

The fly-box, as illustrated, is not permanently secured to the bait platform. Hence it can be easily removed to clean the platform or change the bait. When it is desired to clean the box some gasoline should be splashed into it. This will stun the flies so that they then can be dumped out through the cleaning door and burned.

A Cheap Fly-Catcher

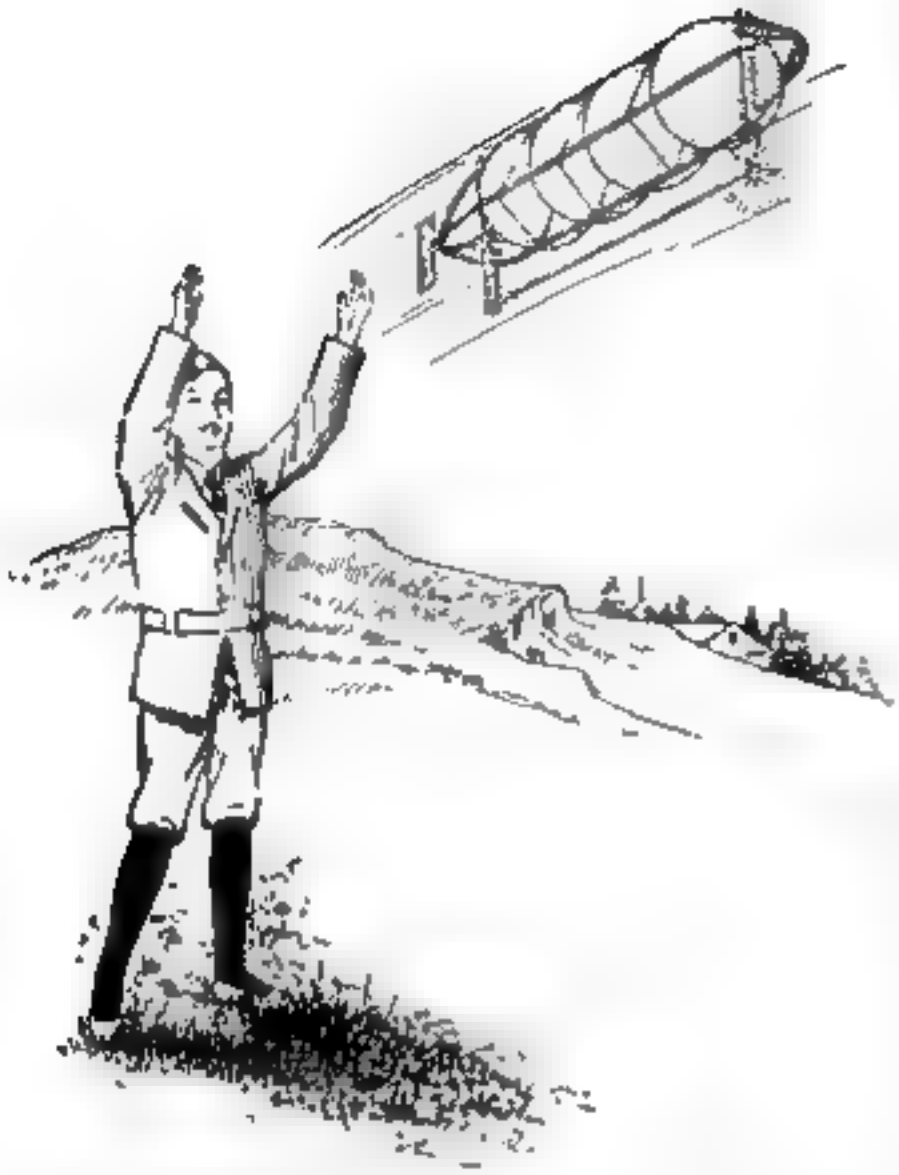
TAKE a glass tobacco jar and make a cone to fit into the top of the jar. Cut an opening about ¼ in. at the apex of the cone to admit the flies. Then place four spring clothes-pins equally around the opening of the jar. These hold the cone in shape and also answer for legs. Place a cup with sour milk under the center of the jar, and as the flies feed they will fly from the cup into the trap. Set the trap in the sun.



Another simple but practical fly-trap

How to Make a Toy Zeppelin

By J. S. Zerbe

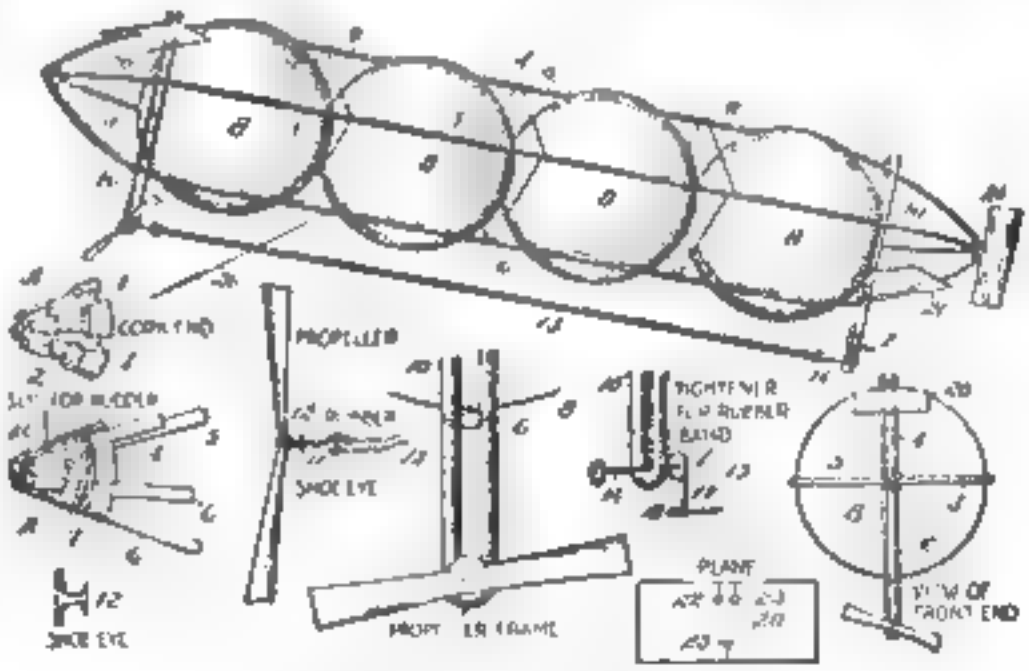


Four rubber balloons in a rattan frame, make a Zeppelin which will actually fly

A TOY Zeppelin is not a difficult or expensive thing to make in the home workshop. All that one needs at the outset is three or four toy balloons and some rattan strips. The first operation is to cut two conical pieces *A* A^1 out of cork. These are ¾ in. in diameter at the base, and ⅜ in. at the apex, the body being ¾ in. long. This has four deep longitudinal grooves 1, and a shallow circumferential groove 2, midway between its ends.

Four lengths of round rattan, 3, 4, 5, 6, are then provided, each being 3/16 in. in diameter. This can be obtained anywhere, and is the lightest material for the purpose. The ends of these four pieces are attached to one of the conically-formed corks, as shown, after they are dipped in glue, and a string 7 used to hold them in place within the groove 2. The ribs thus secured together are ready to receive the balloonettes 8. The rattan ribs are brought toward each other, and the first balloonette placed in. A fine cotton thread 9 is then tied to one of the rattan ribs, and carried down to the next rib and thus secured to the four ribs in such a manner that the ribs are parallel with each other. The three other balloonettes are then placed between the ribs and threads 9 used between the adjacent balloonettes to hold the ribs in alinement. The ends of the rattan ribs are then brought together and secured to a cork A^1, similar to cork *A*.

The cork and rattan frame are so light that the balloonettes readily lift the structure. For that purpose two bent pieces of rattan 10, 10^1 are used, placing one at each end of the frame, so that they embrace the upper and lower ribs 4, 6, to which they are firmly attached by threads. The lower or looped ends are some distance below the frame. The propeller is attached to the forward loop 10. It is made of firm cardboard, first steamed, after which the tips are twisted, and after being dried are fixed to the small end of a shoe eye 12. This serves as a bearing for the propeller. A wire 11, passing through the eye has a hook at its rear end, to which a rubber band 13 can be attached.



Details of the toy Zeppelin

The other end of the rubber band is attached to a hook on the end of a wire

14, the body of which rests in the loop 10^1. The rear end of the wire is bent at right angles, as at 17, and has a double bend as at 18, to furnish a crank, and also provide a means to lock the crank after winding up the rubber.

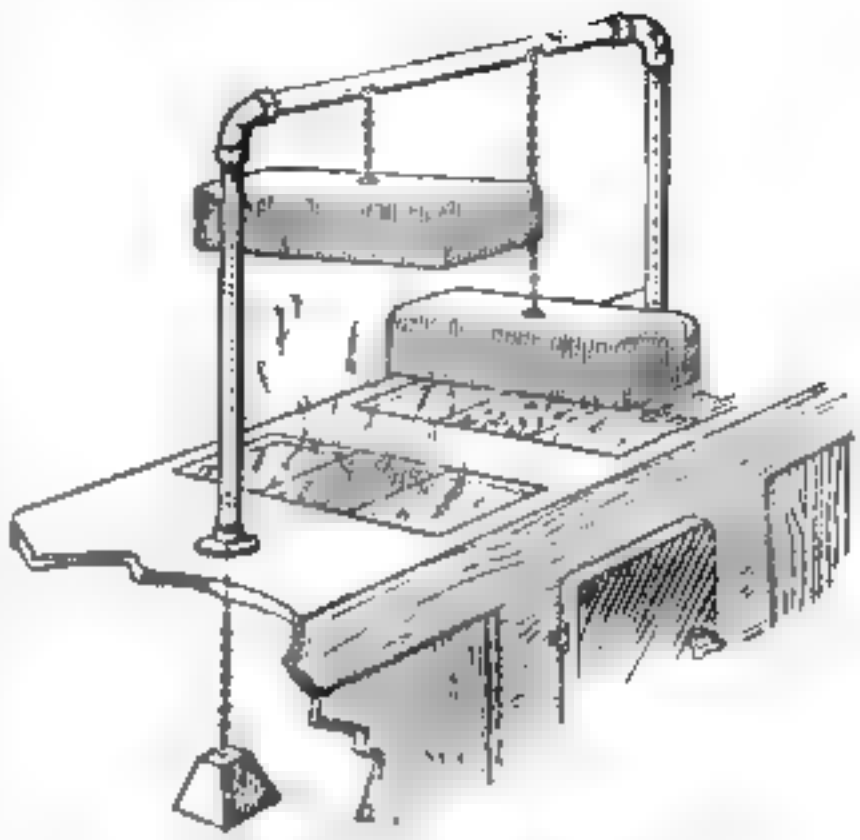
The next operation is to provide a pair of elevating planes and a rudder. The fore and aft planes are similarly constructed, the forward one 20, being attached to the upper rib 4, and the aft plane to the lower rib 6. Each plane is 2 by 4 ins. and at one margin is a pair of slits 22, 22, running into holes which are made to correspond with the vertical loops 10, 10^1, to which they are attached. The other margin has a single slit 23, with a terminal hole, which is attached to the rib of the frame. These two planes are set at the same angle.

The cork at the rear end of the frame has a vertical slit 24, set at an angle, and in this a cardboard rudder 25 is placed. The only thing now necessary is to attach a cord 26 to the lower rib behind the first balloonette, and wind up the rubber band so as to twist it tightly. The moment the dirigible is free it rises, and moves forwardly, the two fore and aft places keeping it on an even keel, and the rudder at the rear having been set to turn it, the machine flies in a circle, being prevented by the cord 26 from flying too high or far away.

Cover Lift for Cafeteria Platters

TO keep the food hot for "help yourself" cafeterias where large and heavy covers are used to protect the platters containing food, a chef has devised a means whereby the covers can be lifted to any position and remain in that position indefinitely. His device consists of two standards and a crossbar, made of pipe and fittings. The standards are about three feet long and the crossbar is long enough to pass over the platters.

Within the crosspipe are located small pulleys and holes made for the chain that suspends the cover. The chain runs over the small pulleys directly above the cover and then over another pulley fastened in the elbow of the pipe, and from there down the pipe below the counter where it is fastened to a weight.



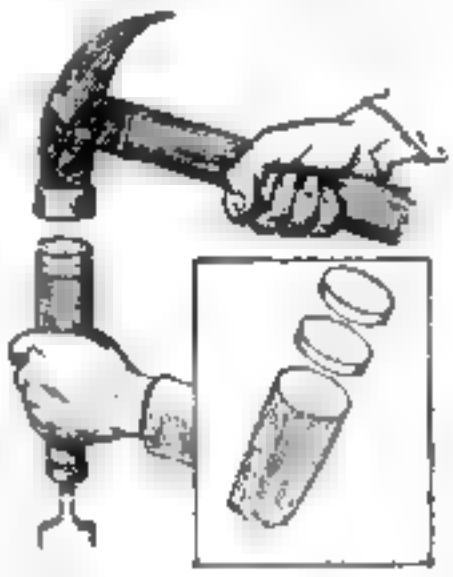
The pulley, chain and weight device lifts the covers out of the way

The lifting weight is sufficient to counterbalance the weight of the cover, so that the latter will remain in any position it is placed. When a customer arrives it is only necessary to give the cover a lift to present the steaming hot food in the platter.

The same cover lifts may be used for cold dishes or, in fact, for any dishes that are exposed to dust. The weight for lifting the cover is increased or decreased according to the size of the cover, and oiled joints insure easy motion at all times.—CHARLES F. SMISOR.

Putting New Life in Chisel Handles

CARPENTERS and mechanics know how soon the butt end of a chisel handle splits when daily exposed to the incessant blows of a mallet or hammer. To overcome this flatten the top of the chisel and attach, with a few small tacks, two disks of leather about ¼ in. thickness to the flattened top. The leather disks should be the same size as the top of the chisel. If the disks overlap and expand they can be easily trimmed to conform to the handle top.—HARRY A. SINGER.



Two pieces of leather lengthen the life of the handle

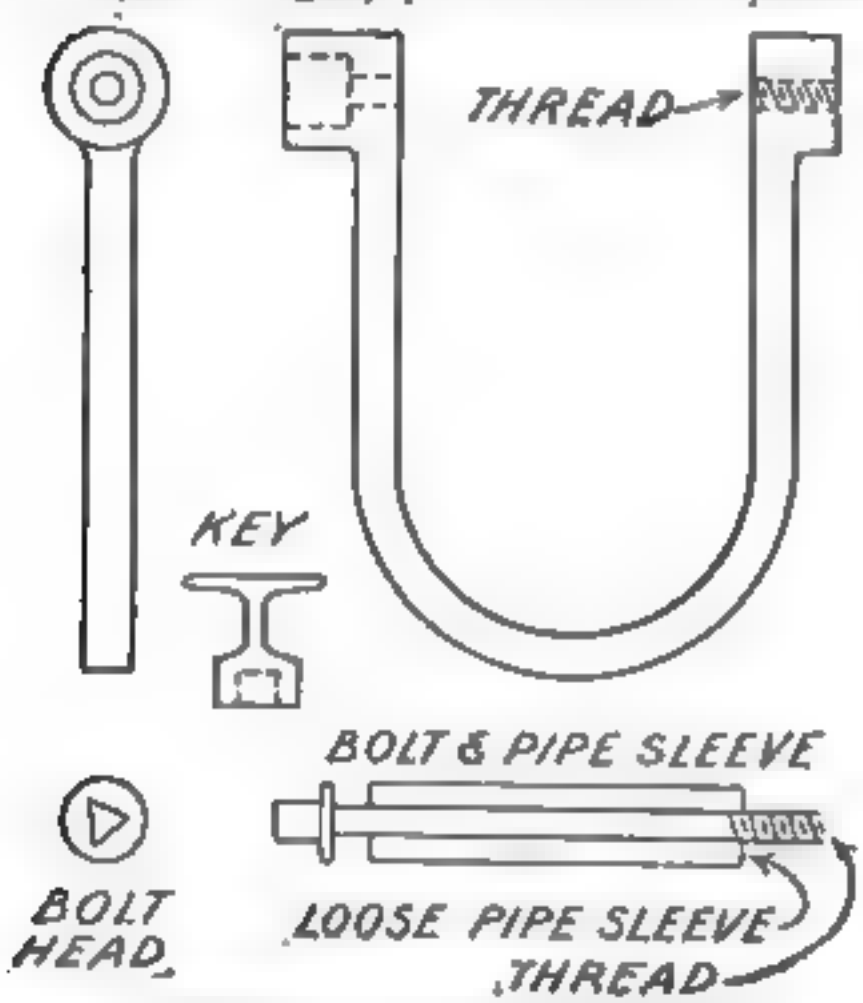
How to Make a Clevis Lock

A CLEVIS lock will be found very useful. The size used to lock a boat can be made of five-eighths round iron, made in the form of a U.

The eyes must be at least one inch across and drilled to receive a half-inch bolt. The top eye should be countersunk or swaged at least five-eighths inch and very nearly through the eye.

The bolt has a thread on one end to fit the lower eye and the other end has a head which can be square, three-cornered, octagonal, or any shape desired. Immediately below this is a collar to keep the bolt from turning in too far.

A piece of gaspipe cut to the required



A clevis lock of simple construction

length protects the bolt from being turned in or out.

A small key should be made to fit the head of the bolt, which must be turned in at least one-half inch below the top.

This lock is secure. There is no danger of any one's unlocking it without the key made for it.—EARL B. SANDERS.

A Handy Bunsen Burner

THE need of a portable Bunsen burner is often felt by one working in the laboratory. The diagram shows how a very handy and useful device can be made.

The fitting from an incandescent gas

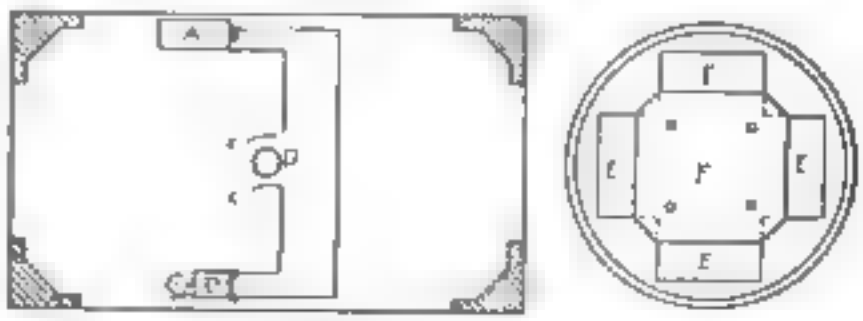
A handy portable gas-burner

light may be used for the mixer. This is to be extended to a length of 5 ins. by fitting a short piece of brass tubing. A 1-in. piece of brass tubing should be screwed to the other side of the fitting. An ordinary tool handle is drilled to accommodate this tube and it is shoved tightly in place, as shown. This tube affords an attachment for the gas hose.

The uses of such a device are countless. It is handier than a gasoline torch for soldering. It may be used for tempering and hardening. Clamped in a retort stand it is of use for many purposes where the ordinary Bunsen burner could not be used.—ROBERT KENNEDY.

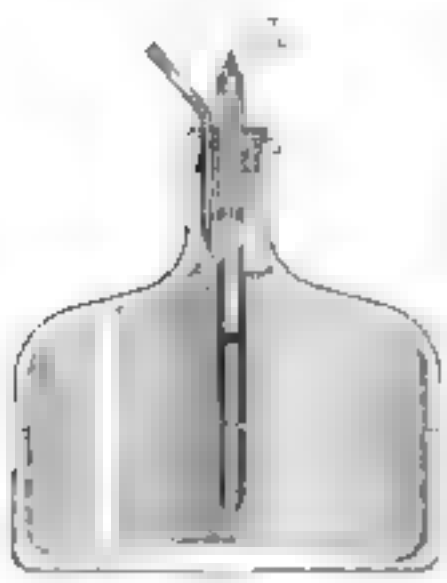
A Simple Overflow Alarm

A NOVEL device which tells when the pan underneath an ice-box is about to overflow is easily constructed. On the bottom side or wall of an ice-box arrange a battery *A* and bell *B*. Leave the two ends of wire *CC*, which is an incomplete circuit, hanging down into the drip-pan into which water drips from the outlet *D*, above. A wooden float is placed in the pan and on it is attached a copper plate *F*. When the float rises the plate is brought into contact with the two ends of wire, completing the circuit and setting off the alarm.—M. J. SILVERSTEIN.



Under side of refrigerator, showing construction of warning device

An Alarm Bell for Chemists

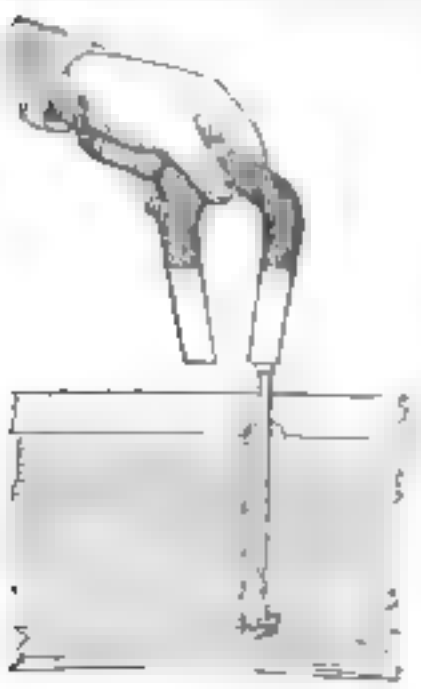


IN chemical laboratories, where various liquids are treated by slow processes, the receiving bottles often overflow, thereby wasting material and incurring a risk of damage, if the liquid is of a destructive nature. An attachment for bottles that will cause an alarm bell to ring can be installed cheaply.

The device consists of an electric contact made to close by the pressure of a float which rises in a tube as the level of the liquid nears the top of the bottle. A long tube, thrust through a rubber cork into the solution, contains a drawn-glass tip, from the ends of which platinum wires protude. At the upper ends they are connected to batteries and a bell. At the lower end they are bent into any desired shape, so that the circuit is closed when the float rises.

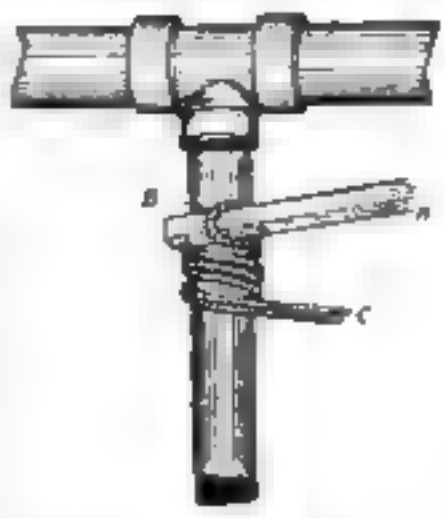
The float consists of a sealed-off glass tube containing a drop of mercury to prevent it from being too buoyant. The float can be tipped with metal, so than an electrical connection is formed between the wires when the tip touches them; or it may consist merely of the sealed-off tube, which, in rising, presses the wires together. The lower end of the tube containing the float is curved inwards, so that the float will not drop out when the device is removed.

Getting Iron Scraps Out of Deep Holes



A PIECE of iron or steel can be removed from a small, narrow hole with the use of a horseshoe magnet and a nail. The nail is magnetized its full length and thus attracts the piece of iron or steel which can then be very easily removed.

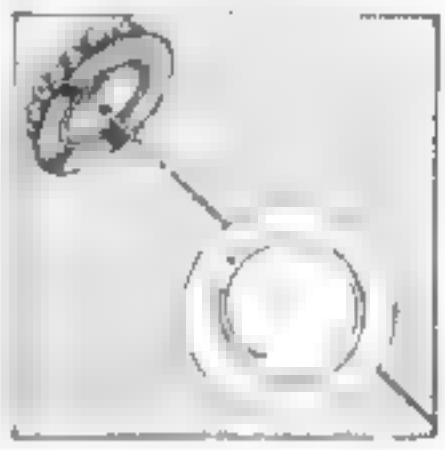
Rope and a Lever as a Pipe Wrench



SOMETIMES in tightening or loosening pipes and pipe fittings, a suitable wrench may not be at hand. This difficulty is easily overcome by using a piece of rope and a lever which may be a bar of iron, or a piece of pipe or wood.

The method of using this device is shown in the accompanying illustration. The rope is doubled and given a few turns about the pipe (enough to insure a grip), the lever *A* is then inserted in the loop of the rope at *B*, and a strain is put on the end *C* to prevent the rope's slipping. The more turns of rope about the pipe, the less strain is required at *C*. The pipe is turned by the lever *A* the same as by any pipe-wrench used by steam-fitters.—WILLIAM PHILIP.

A Safety-Holder for Hatpins

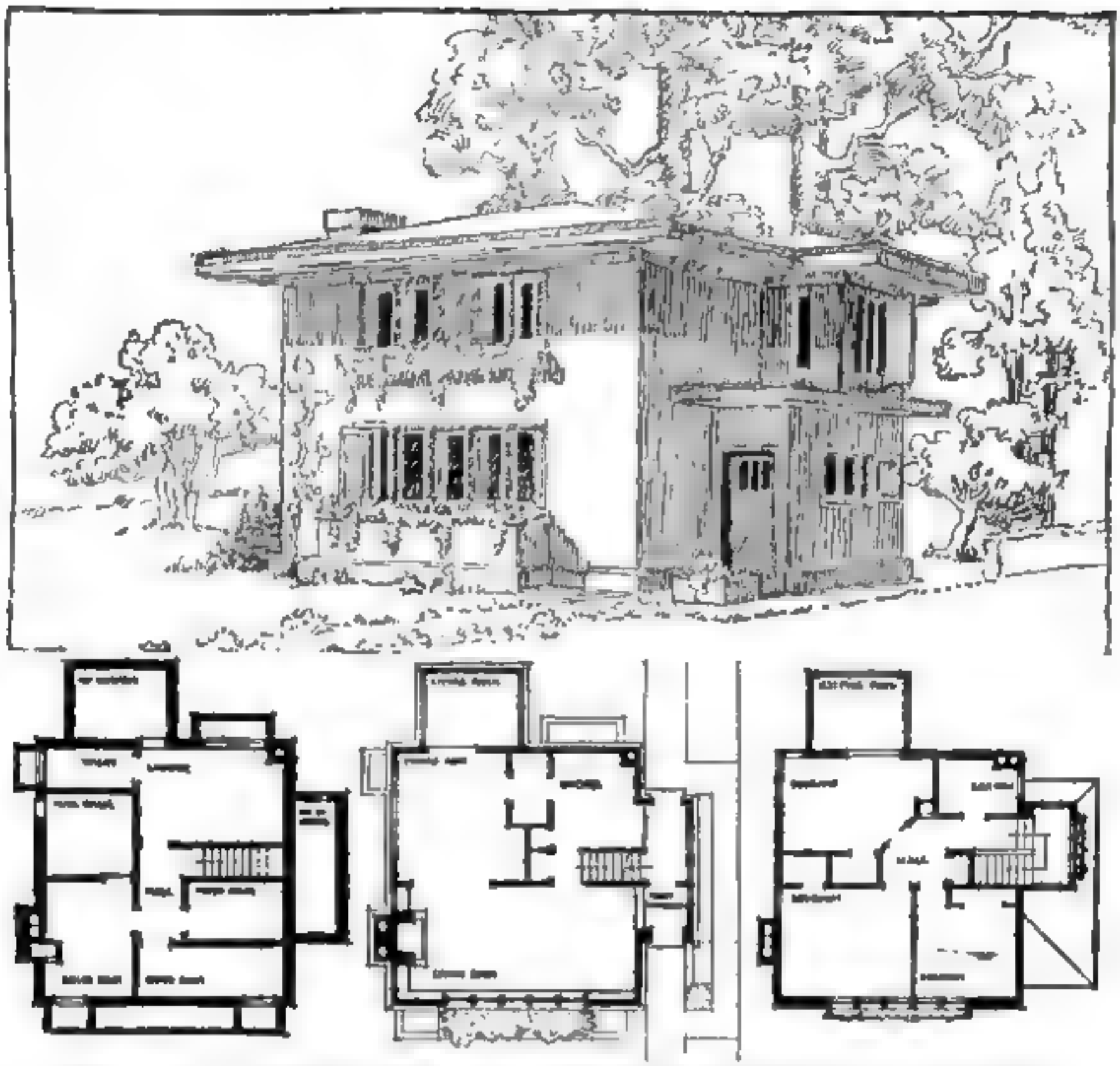


THE loss of an expensive hatpin may be prevented in the following manner. Cut 4 ins. from the point of an old hatpin; and bend it into a ring, allowing the point to overlap the blunt end about ½ in. Bend the point slightly to one side so it can catch on to the hat.

Solder the ring on to the back of the head of the hatpin. When the pin is inserted in the hat, it is slightly turned to enable the curved point to grip the material of the hat, thus preventing its being lost.—THOMAS SHEEHAN.

Taking the Yellow out of Rubber

OFTEN experimenters find that hard rubber is affected by the sun, which gives it a yellowish color. A good remedy is to rub the rubber with dry pumice until the powder turns yellow and then to polish with carbon disulphide which can be bought at any drugstore. This gives it a beautiful black finish.



This house can be built for $3500. It was designed by the Minnesota Art Commission

What Home Builders Really Want

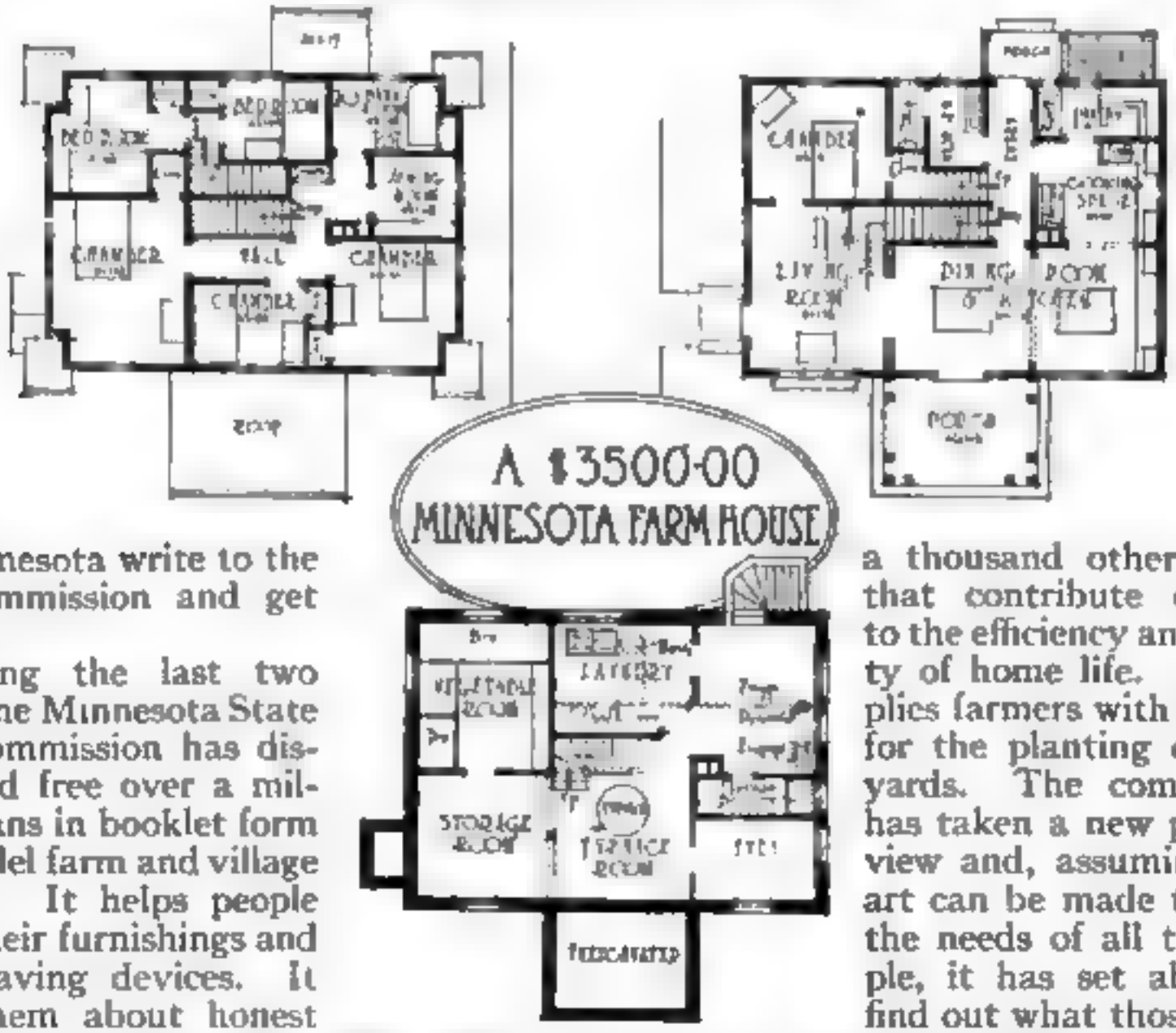
Taking the Advice of Plain People

By Maurice Irwin Flagg

IT is hard to imagine art as a business builder for the farmer of Minnesota, or in fact of any other state. Most art programs shoot into space. They over-reach the mark, with the result that art, instead of becoming a common possession of the common people, is a pastime or pleasure and the plaything of the wealthy.

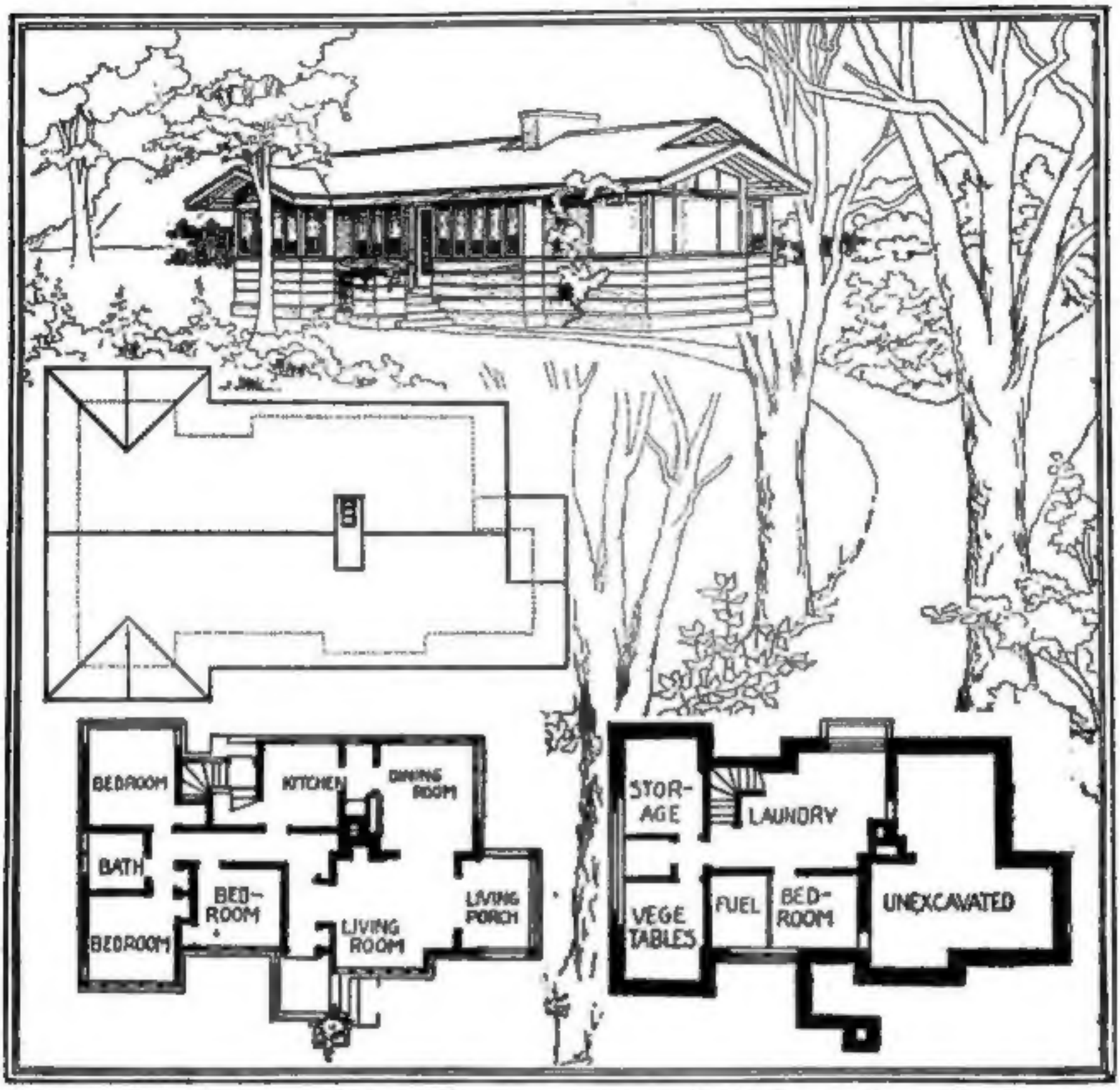
The Minnesota State Art Commission is a department of the state government. It was created by an act of the legislature some fourteen years ago. It has been slowly but productively tilling a virgin field which is now bearing crops far beyond the hopeful anticipations of those who were responsible for the commission's inception. The farmers in Minnesota are walking arm in arm with the art commission. The people of the small cities and villages consult the commission upon all sorts of questions. If the chimney smokes or the plumbing balks or the furnace fumes, the people

Model village house plans, some of wood and others of stucco, designed by the best architects in Minnesota, have been placed at the disposal of the small house builder. A photograph of this $3500 house appears on page 320



of Minnesota write to the art commission and get help.

During the last two years the Minnesota State Art Commission has distributed free over a million plans in booklet form for model farm and village houses. It helps people with their furnishings and labor-saving devices. It tells them about honest building materials, the right kind of paint, plumbing, heating, shingles, and a thousand other things that contribute directly to the efficiency and beauty of home life. It supplies farmers with designs for the planting of farm yards. The commission has taken a new point of view and, assuming that art can be made to meet the needs of all the people, it has set about to find out what those needs are and then to supply them in a practical and businesslike way.



The artistic and the practical are being successfully combined in inexpensive western homes

One western city is using twelve hundred of the model plans every month. They are placed in the public school to be studied

A meeting was called of practical farmers, art commissioners, architects and agricultural experts. The farmers said, "We want a farmhouse service if you can supply it. We don't want any city-made plan. We want a house with modern conveniences in farmer's style." "All right," replied the art commissioners, "Tell us what you want and we will give it to you." The farmers answered, "Ten rooms with a bath and separate quarters for the help. We want set tubs and running water, and labor saving devices because the farmer's wife is an asset that demands conservation. We want all this for not more than $3,500." The art commission consulted the Minnesota Chapter of the American Institute of Architects who agreed to endorse and support a model farmhouse competition. The commission raised a substantial amount of money for prizes, and the farmers dictated the terms of the competition. The farmers were asked to serve as a jury, along with the architects and agricultural experts.

Model Minnesota farmhouse erected on the State Fair Grounds. The plans are given on page 318

The competition was open to anyone living in Minnesota. It brought together thirty splendid model farmhouses which were considered worthy to be judged in the final awards. But what was in a measure more hopeful than even the accepted drawings, were the hundreds of ideas submitted by farmers and farmers' wives from all sections of the state. Some of the plans were submitted on wrapping paper, others on birch-bark and still more on shoe-box covers, showing all the elevations, even the water running in the kitchen sink.

In two years' time, over a million plans have been sent from the offices of the State Art Commission and these in booklet form, free. If a farmer wants full size working-drawings and specifications, he can have them for just the cost of making the blueprints. Working drawings are sold by the commission for $3.50 to anyone living in Minnesota and $5.00 to anyone living outside the state.

The commission set about to build a model farmhouse for demonstration and through the co-operation of the building material interests it built upon the State Fair grounds a complete first prize design. This house is properly landscaped and furnished from attic to cellar. Every labor-saving device and every modern convenience shows the farmer and his wife what can be done for a certain amount of money.

A new kind of farmhouse is being built in Minnesota. The plans have been sent to the far corners of the United States and other countries. The plans and even a small-sized model have circulated through Minnesota to farmers' institutes and short courses. The farmer and the Art Commission in Minnesota are on speaking terms now. The commission is able to assist in the selection of the wall paper. And this helps some in advancing the cause of pictures and "old masters."

This farmhouse campaign was only a beginning. People living in the small towns and villages said, "Why not do something for the small home builder who cannot afford to employ an architect? You have helped the farmer, now do something for us." A second competition for a model village house was held. This house was to cost $3,000 complete. The architects enthusiastically endorsed and supported this competition and from it came some fifty of the most attractive and "architecturally fit" houses that have ever been accumulated. The immediate result was a great state-wide interest in better farmhomes and a quickining of home interests.

The October Issue of The Popular Science Monthly

What the War Has Done For the Aeroplane

The battlefield is to the aeronautic engineer a huge laboratory for the testing of aeroplanes. More progress has been made in designing flying machines since the war began than most of us imagine. Wouldn't you like to know just what the war has done to bring us measurably nearer the day when we will trundle out a flying machine as easily as if it were an automobile and whirr away from our country homes to our offices? The October issue will tell you.

Handling New York City's Traffic in a New Way

New York, the greatest city of the Western Hemisphere, is a little, long island, packed with people, trolley cars, wagons, dwellings and office buildings. It has the most difficult traffic problem in the world. To handle the millions and millions of tons of freight brought in by steamships and railways, a crude and antiquated system is still in vogue. In the next issue of the Popular Science Monthly we will tell how great engineers propose to solve this traffic problem scientifically.

Harnessing the Sun in Egypt

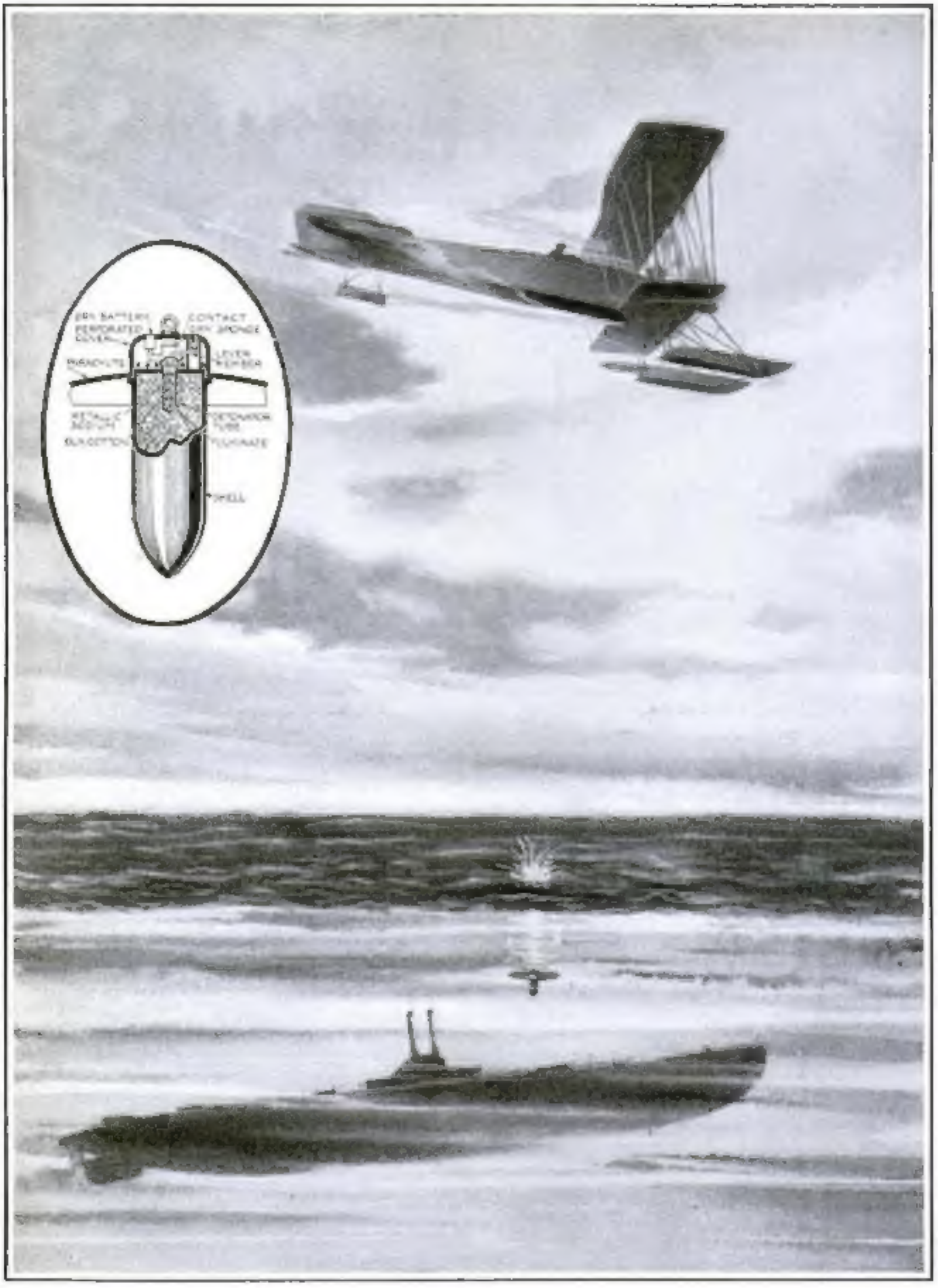
The sun is hot. Every boy knows that who has ever used a burning glass. Isn't there some way of heating water with the sun and driving a steam engine—some way of putting the sun to work? The Popular Science Monthly for October will tell all about the wonderful plan of a Philadelphia inventor to harness the sun.

Motoring on Roller-Skates From Home to Office

It sounds fantastic, but inventors have been so successful in motorizing the roller-skate that before long it will be possible to skate your way to work each morning. Read about it in the October issue.

In the same issue and regularly thereafter you are to be informed of the latest happenings in the great field of astronomy.

These are only a few of the articles which are to appear. Remember that each month there are three hundred articles and as many pictures—all intensely interesting, all dealing with new things in science and invention which you ought to know to keep abreast of these stirring times.



The airman is monarch of all he surveys—including the enemy submarine submerged thirty to forty feet under the water which is perfectly visible to him. He releases a bomb which is guided in its descent to the water and its speed under the water by the parachute, which is a dished circular plate. Two means are used to explode the bomb. Water flowing in through perforations either fires a quantity of sodium which in turn discharges the fulminate, or it completes the circuit of an electrical igniting apparatus setting off the bomb